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# The Mining Journal

London, November 13, 1959

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### Editor

U. Baliol Scott

### Deputy Editor

A. Graham Thomson

### Assistant Editor

R. Bowran

### Assistant Financial Editor

R. A. Nuttall

### Display Advertisement Manager

E. S. Hooper

### Circulation

Robert Budd

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### Directors

E. Baliol Scott  
(Chairman)

U. Baliol Scott  
(Managing)

G. A. Baliol Scott

R. A. Ellefsen

**15 WILSON STREET,  
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Telegraphic  
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## Famine in the Midst of Plenty

FOR several weeks copper prices on the London Metal Exchange remained surprisingly steady, despite the withdrawal of supplies from most United States sources, even when the situation was aggravated by the cessation of work at El Teniente. Towards the end of October, however, the physical effects of the strikes, coupled with growing fears that other Chilean mines might be brought into the Braden dispute, led to a sudden flurry of prices. However, the settlement of the Braden dispute has averted what seemed to be a very real possibility of simultaneous nation-wide stoppages in the two largest producing countries.

By the end of October the combined loss of copper from the U.S. and Braden strikes had already reached or exceeded 200,000 tons, equivalent to six per cent of the estimated Free World's annual output. So far, there is no indication of an early ending to the stoppage in the U.S. industry, which seems likely to last throughout November and which the extension of the strike to White Pine has rendered virtually complete. The position has not been improved by the explosion at the plant of American Metal Climax, which is resulting in a further loss of copper, while there is a possibility of strike action arising at yet another plant through failure of the talks between the American Smelting and Refining Co. and the Mine Mill and Smelter Union at Denver, which have made little progress. Fortunately the prospect of a stoppage at the Perth Amboy refinery of International Smelting and Refining Co. has been averted. In all these circumstances, it is scarcely surprising that the settlement of the Braden dispute brought no more than a temporary easing in prices.

So far the effects of the copper strikes within the United States itself have been mitigated by the large stocks held by consumers when the strike began. A nation-wide survey made by the *American Metal Market* at the end of October found most consumers equipped to carry on normal operations until the end of November and some to the end of the year. Declining supplies of electrolytic copper, however, were expected to force one of the biggest wire and cable firms to start layoffs at some of its plants within two weeks. Nevertheless most brass mill and foundry executives were found to be as much concerned by the effects of the steel strike on their businesses as by a possible copper shortage. The steel strike is causing extensive cutbacks in construction, motor cars, heavy machinery, and related fabricating concerns, with a corresponding decline in the demand from these industries for copper-base metal products.

It has also to be remembered, however, that a shortage of copper will have a slowing-up effect on the American economy, quite apart from the shortage of steel, because there are a number of uses of copper in which steel plays a minor part. It follows that, as America runs out of copper, there will be heavy pressure on the market, whatever the steel situation. Bearing in mind that the copper dispute, like all current American strikes, is basically a struggle over restrictive practices, it might well be protracted and the squeeze in American copper may cause prices to climb very steeply.

At the present time, however, the main element in the American price squeeze is not that there is a world-wide shortage of copper,



but that the U.S. market takes the view that any copper America succeeds in importing must arrive before December 27, the date on which the 80-day cooling-off period in the longshoremen's strike ends. Fresh legislation would then be needed to prevent the longshoremen coming out again, but Congress does not meet until mid-January, and it is considered unlikely that a special session would be called for this emergency alone.

Assuming no sudden disruption of supplies in the Belgian Congo or Rhodesia, there seems little prospect of any real copper shortage developing outside the United States, and the squeeze is unlikely to be of long duration. Consumers' stocks, together with the metal currently coming forward on long-term contracts, should be quite adequate to take care of the rest of the world. Users in this country and the Continent receiving copper under long-term contracts have already resold whatever they can spare up to Christmas, but at present prices could certainly be induced to make more copper available today for Jan.-Feb. delivery in the U.S., if it in fact were called for. The one minor short-term factor limiting the extent to which stockholders might be willing to sell, is the need to ride the three weeks' gap in supply from Chile, caused by the recent strike, which will make its impact in Europe towards Christmas.

Meanwhile, on this side of the Atlantic, the pressure on nearby copper has led to a sharp increase in the backwardation, which seems likely to widen further. Stocks in the L.M.E. warehouses have been declining steadily and new demands on the market are coming from all quarters. Apart from the United States itself and Western European countries, Russia has been a buyer, mainly of blister, while there has been some Chinese buying of wire rod in the London market. China is also reported to have resumed general buying in France after an absence of over six months and recently she placed an order with French cable manufacturers for 2,000 tons of copper wire.

So far as the medium-term outlook is concerned, the position has not fundamentally changed. Production capacity remains more than sufficient to take care of any probable increase in consumption for a considerable time to come. Hence the reluctance of Rhodesian producers to increase their output on account of a temporary shortage, which might well have ceased to exist by the time any additional supplies made available by such action could reach consuming points.

The knowledge that existing production capacity in Free World countries, when fully utilized, is substantially in excess of the present level of consumption, doubtless contributed to the steadiness of copper prices in the early weeks of the strike. A further restraining influence was the shadow of the U.S. stockpile. The Office of Civil and Defence Mobilization, however, has categorically stated that stockpiled copper would not be released to help out or to ease market conditions because of shortages caused by labour strikes in the U.S. and foreign mills. On the other hand, there was nothing in last week's statement which suggests that Washington would be prohibited from unloading stocks after the strike was over to help out consumers. However, this is a risk which the Administration might be unwilling to take in view of the certainty that the surplus would quickly reappear, once production was again in full swing. It is noteworthy that, in spite of O.C.D.M.'S. statement, fresh rumours of a possible U.S. stock-pile release were current this week.

Meanwhile the present emergency can only be harmful to the copper industry, since the interruption of supplies to American consumers can scarcely fail to give a renewed impetus to substitution, which will gain increasing momentum as the strike goes on. This is a most unfortunate setback to the efforts of major producers to promote consumer confidence in the maintenance of assured supplies at stable prices.

## RELUCTANT PEACE

By his invocation of the Taft-Hartley Law, President Eisenhower has achieved his main objective. He has ended the seventeen-weeks' stoppage in the U.S. steel industry and enforced the reluctant return to their daily avocation of half-a-million steel workers.

For the nation the resumption of steel production had become a paramount necessity. Unemployment has become a serious problem in the United States on a far worse scale than anything experienced in the U.K. or in Western Europe, and it has undoubtedly been considerably exacerbated by the stoppage of the major steel plants and the formidable lay-offs in the steel-using industries in consequence of the lack of essential supplies.

Most seriously affected has been the motor industry, already confronted with formidable British and European competition. Car factories have either been shut down or reduced to short-time working and General Motors alone have laid off over 200,000 men. Many thousands of railroad workers and miners have also been rendered idle. Now the Courts have upheld the contention that the strike had created a grave national emergency, which justified the enforcement of the provisions of the Taft-Hartley Act.

Only a temporary peace has been achieved. The half million strikers, impoverished, no doubt, by the longest stoppage in the annals of the U.S. steel industry, have reluctantly returned to work with none of their grievances, real or imaginary, settled. Only time has been gained, time in which to bring the disputants together and achieve a negotiated settlement. It is a respite of limited duration, which throws back on the union spokesmen and the employers the responsibility of working out the terms of a durable settlement.

The prospects of such a happy consummation are not unhopeful. The United Steel Workers Union is already reported to have made a sizeable cut in its wage demands, and the Kaiser Steel Corporation promptly broke away from "the big twelve" by negotiating an independent agreement which has enabled the company to restore its mills to full-scale operation.

Many of the smaller steel plants, moreover, have been enabled to maintain continuous production throughout the strike period under special agreements with the Union. Wage clauses in "little steel" usually follow the pattern of those of the big producers and the Union has apparently agreed to the working of the smaller plants until a final settlement with the big producers.

To this extent the so-called nation-wide stoppage has fallen short of 100 per cent, and the contribution of little steel has been by no means negligible. It is estimated that the annual capacity of these smaller plants amounts to as much as 22,000,000 tons which approximately equals the total current output of British steel.

Such little information as has been allowed to leak out concerning the discussions between Mr. Macdonald, the big chief of the United Steel Workers Union, and the representatives of the employers conveys the impression that the major obstacle to a settlement revolves around the dispute over working rules.

Both sides are appreciative of the dangers of inflation. Industrial leaders appear to be reconciled to a limited increase in the wage packets, which would possibly be absorbed without an advance in prices, and the Union appears to be fully conscious of the undesirability of pressing higher pay claims to the point where higher prices must ensue.

The more contentious issue is the employers' claim for greater authority in determining working rules. In effect, employers argue that the attainment of higher efficiency,



which alone would enable them to meet the financial cost of a wage increase without further price inflation, is only possible by a drastic revision of working practices.

Can such changes be effected without undue hardship for the workers? They think not, and this in fact has become the very kernel of the dispute. Arbitration has been rejected, but that is not the end of the matter. A way out of this dilemma must be found, and that quickly.

Eighty days should be sufficient to work out an agreement. Interests far wider than those of the steel industry are involved and certain it is that the imponderable, but none the less powerful, force of public opinion will be directed against an intractable attitude by either of the disputants. A second stoppage early in the new year is a prospect too intolerable to be contemplated.

#### TAXATION CONCESSIONS IN AUSTRALIA

The Commonwealth Government has granted some taxation concessions to mining companies which will be helpful, but the industry would like further moves in this direction. One question of very great importance is that of the provision of housing for mine employees, and adequate consideration for the capital expenditure involved, usually, under present-day conditions, at the commencement of the enterprise, and before the actual proving of the mine. Mount Isa Mines fought this issue with the Queensland Taxation Commissioner, and was unsuccessful in securing taxation rebate. A recent Government announcement states that mining companies which provide amenities and housing for employees in the vicinity of a mine, will be permitted to deduct the cost in five annual instalments. This concession will also be available for the 1958-59 income year but the expenditure on housing and welfare in 1955-56, and subsequently, may be deducted to the extent that it does not qualify for deduction from the income of years before 1958-59.

New concessions in tax deductions for capital contributed to companies for oil exploration extend the provisions of the 1958 legislation to amounts contributed after September 30, 1958, without regard to the date of allotment of the shares. Companies incorporated in Australia, in which non-residents hold a controlling interest, or own more than half the subscribed capital, will be entitled to the deductions, but capital contributed by non-residents will not be eligible.

A further concession, in some circumstances, is to shareholders of a company which does not engage in oil exploration, but which subscribes capital for oil search. The deductions will be allowable only after the capital has been passed to the operating company. The benefit of deductions is extended also to dealers in shares on a basis similar to that applied when a primary producer is allowed deductions for the cost of developing land sold by him.

#### URANIUM RESOURCES IN JAPAN

A three-year programme of prospecting for uranium deposits over an area of 80,000 square kilometres in Japan has just recently been completed. Begun in 1956, it is a prelude to the planned survey of 200,000 square kilometres, or about half of the land area of the Japanese islands.

Results so far obtained have established that the Ningyotogo mine, located on the border between the Tottori and Okayama prefectures, in the western half of the main island of Japan, contains the richest deposit, estimated at about 1,500,000 tons. Other major deposits include those at the Kurayoshi mine, in the Tottori prefecture, and the Iwai and Nodatamagawa mines, in the Iwata prefecture.

The surprising lateness of this programme is accounted for by the fact that it was not until 1954 that the Japanese

Government made any budgetary appropriations for nuclear energy development. Since that date, however, work has been conducted on the search for domestic sources of uranium in accordance with a definite plan, as part of the general programme for the development of nuclear energy.

The entire work has been carried out by the Ministry of International Trade and Industry's Geological Research Institute and the Nuclear Fuel Corporation, with the co-operation of some private enterprises and of the universities and the various other public bodies which have become concerned. The Government has granted subsidies to private bodies engaged in prospecting for uranium deposits and in the manufacture of the necessary equipment.

As regards the extraction of uranium metal, research has been carried out by private institutions and state-run laboratories. A test plant for the development of uranium smelting technology is expected to be completed by the end of this year by the Nuclear Fuel Corporation.

#### MINING PROJECTS IN MOROCCO

The Moroccan-American Development Corporation of Casablanca has announced plans to develop a deposit of graphite and vermiculite near Tetuan, north Morocco, which it is hoped will produce at least 1,000 tonnes monthly of graphite after an initial investment of about two million dollars in the first year.

The 17-sq. ml. concession of Bouxera, 25 miles south-east of Tetuan and only a few hundred yards from deep water on the Mediterranean coast, has been leased by the M-A Development Corp. from Mauretania S.A., a Spanish company whose average production over the last ten years or so has been in the region of 35 tonnes a month. According to surveys made by Mauretania and by the Denver Equipment Company of London, the deposit contains between 1,500,000 and 2,000,000 tonnes of high-grade graphite which could be easily refined on the spot with suitable equipment to 85 per cent purity.

With finance from the American & Foreign Bank of Tangier, the M-A Development Corp. plans to install new milling and refining equipment on the site of the mine, and to export the product directly from the mouth of the valley in which the mine is situated, instead of transporting it by lorry to Tetuan as Mauretania used to do. A project has been submitted to the Mines Department in Rabat suggesting that the Moroccan Government's Bureau d'Etudes et de Participations Industrielles (BEPI) finance the construction of a wharf to make it possible for the graphite to be shipped for export.

A nearby deposit of vermiculite is entirely undeveloped and surveys are to be undertaken to establish whether it is commercially exploitable. Industrial garnets present in the graphite will also be exploited.

According to the Government's Mines Department, an announcement will be made soon regarding an official project for the construction of a supertriple phosphate plant in Morocco, to produce 200,000 tons annually and to cost "several milliards of francs". Officials say it would be financed partly by the Government here and partly by foreign importers of phosphate in Britain, W. Germany, Italy, Belgium, France and in Scandinavia.

Officials also say an important project will be published before the end of the year regarding the construction of a steel plant. There have been tentative offers received here from United States, French and W. German interests for the construction of the plant which, officials say, will not employ the R-N (Republic Steel-National Lead) process as previously reported.

**N**OT the least interesting development in this year's ore and metal markets has been the very marked improvement in the demand for columbite. Following the cessation of the U.S. stockpiling programme at the end of 1955, the bottom dropped out of the columbite market and for three years in succession world production declined very sharply. In 1958 the Nigerian output of columbite ore and concentrates amounted only to 805 l.tons, compared with 3,047 l.tons in the peak year 1955. By the end of last year, however, interest in columbite began to revive and in recent months the demand for high grade columbite has picked up considerably. Nigerian producers were able to report profitable contracts for all the production in sight for 1959 and some for 1960. No difficulty is being experienced in disposing of 5-ton lots in the open market at 165s. - 175s., according to the columbium-tantalum ratio. In the first six months of the current year exports of columbite from Nigeria totalled 931 tons. In June 123 tons were exported.

#### Niobium's Encouraging Prospects

In our issue of August 14, 1959, p. 146, we referred to the highly optimistic view of niobium's future prospects now widely prevalent in the U.S. Encouraging progress was recorded in 1958, when the U.S. production of niobium metal from imported Cb-Ta concentrates and domestic ore approximately trebled, but in terms of metal in ore, U.S. consumption of niobium in the first six months amounted only to an estimated 210 l.tons. U.K. consumption is estimated to have totalled 138 l.tons (metal content) in the whole of 1958. The entire world consumption of niobium is probably under 1,000 tons a year.

Looking to the future, however, outputs measured in thousands of tons annually, perhaps within five years, are being forecast in the U.S. for an industry based on the production of pure ingots alone, without taking into account columbium's already established uses. But all this has still to come. There is as yet no indication that the mass tonnage uses now confidently awaited have reached the stage of commercial development, though the opportunities for some of the new niobium alloys now reaching the market are regarded as potentially very great.

In the United Kingdom there is a growing interest in pure niobium, more especially from research and development groups. Britain's sole producer, Murex Ltd., recently brought a new niobium-tantalum plant into operation and is well equipped to meet future needs.

The fact that as much as \$4,000,000 a year is currently being spent in the U.S. on niobium alloy research has doubtless been sufficient in itself to inject new life into the columbite market. At the same time, it seems a safe assumption, in the absence of up-to-date consumption statistics, that there has been a substantial recovery in established uses, in line with the rising trend of U.S. steel production during the months preceding the present strike, and with the upswing in the American economy as a whole. Another factor contributing to the improved demand for columbite may be the building up of stocks against the expected expansion in niobium consumption in the coming years.

So far as the immediate future is concerned, Mr. H. K. Intemann, president of Union Carbide Metals Co., has forecast a possible 25 per cent rise in sales of ferro-columbium alloys in the U.S. during 1959. Among the developments he anticipates is the growing use of niobium additions to carbon and possibly low alloy steels. It is claimed that, where design permits, very large weight and cost savings can be effected by replacing mild carbon or alloy steels with niobium-treated steels, which are stronger and tougher than ordinary mild carbon steels. An interesting development in this connection

# Columbite Return

is the introduction of exothermic alloys which can be added in quantities to the ladle without excessive temperature loss, and without contact between the alloy and the furnace slag—thus assuring higher, more consistent recoveries in the steel. The complete series of exothermic alloys now in production can be used in almost all types of alloy steels and irons.

#### High Temperature Applications

A bright future is seen for niobium in new high temperature alloys and alloy steels for missiles, supersonic aircraft and nuclear reactors. Niobium may have the highest strength-weight ratio of any engineering metal at the incandescent temperatures that will be encountered in future Air Force engines, airframes and missiles. Of the possibilities for high niobium alloys for jet engine use, Ronald L. Carmichael, of Battelle, writes that columbium-containing materials permitting operation in the range of 2,200 deg. F. might be produced. Alloys usable to 1,700 deg. F. without protective coatings have been developed that do not contain columbium. If columbium-containing alloys are developed that can raise current jet engine temperatures by only 100 deg. F., they could probably be incorporated in jet-engine designs.

If such alloys are incorporated in present jet engines, then two years, and possibly three, will be necessary for the metal or alloy to reach its peak production. If, however, an alloy is developed that enables present operating temperatures to be exceeded by more than 100 or perhaps 200 deg., it would be necessary to redesign the engine. In this event it would probably take five or more years fully to develop the use of columbium as an alloy for this purpose.

If a successful high-columbium, or columbium-base alloy is developed, states Carmichael, and its price is commensurate with the gain in properties, then a market for columbium for this purpose of the order of 450 tons annually can be envisaged without too much difficulty.

In this connection it is noteworthy that the Crucible Steel Co. of America was recently awarded a contract by the Air Materials Command for developing a process for the manufacture of niobium alloy sheets, 36 in. x 96 in. The Air Force will make the final alloy selection and sheets produced by the process will be submitted to various aircraft and missile manufacturers for evaluation.

Interest in niobium's high temperature properties is not confined to military programmes for the development of aircraft and guided missiles, for airframe manufacturers are

# To Favour

reported to be thinking ahead to the commercial aircraft which will replace the new jets now coming into service, probably some time between 1965 and 1970. Passenger transports flying at Mach 2 to Mach 5 are expected to be in service by 1970, and they will also require materials capable of giving dependable service at extreme temperatures.

Two new alloys apparently of a revolutionary nature are described in a brochure issued recently by the Flight Propulsion Laboratory Department of General Electric, which has been working in the field of niobium alloy development since late 1955, particular emphasis being placed on the development of alloys having high temperature strength for application in the temperature range 2,000 deg. to 2,500 deg. F. One niobium alloy, known as F-48, contains 15 per cent tungsten, 5 per cent molybdenum, and 1 per cent zirconium plus carbon and oxygen. The second, F-50, is similar in composition but with the addition of 5 per cent titanium, made to improve oxidation resistance further at a sacrifice in strength.

On the subject of protective coatings, G.E. state that a number of the coating systems found to be of value for molybdenum were almost directly translatable to the protection of columbium. The result of puncture or cracking of the coating system during simulated service testing of columbium alloys to 2,500 deg. F. is much less serious than with molybdenum, since no volatile oxide is formed. Results with ceramic type coatings have demonstrated adequate protection of columbium up to 2,500 deg. F. for short periods of time.

It is concluded that columbium-base alloys are likely to find their most useful applications in the temperature range 1,900-2,500 deg. F. in stressed components. The lower limit of this range is based on the applicability of nickel-base alloys up to about 1,900 deg. F. The upper limit is based on present knowledge of the strength and oxidation resistance of niobium-base alloys.

## Niobium in the Nuclear Field

In the nuclear field the properties of niobium that will attract attention include its low nuclear cross-section, its strength at high temperatures in inert atmosphere, and its corrosion resistance. Niobium's excellent compatibility with the fuel and liquid coolant and its good creep strength at the high fuel temperature offer considerable attraction as a canning material. Another important application is as an

alloy for uranium in fuel elements. The addition of 10 at.-% niobium to uranium stabilizes the *gamma* body-centred cubic structure of uranium at room temperature.

In a survey entitled "Niobium (Columbium)—its Future Prospects" (*Metallurgia*, Vol. 59, No. 354, April 1959), J. Sandor points out that, according to one estimate, possibly no more than 30 tons of high purity niobium metal may be used annually in the nuclear field. On the other hand, the use of stainless steel in nuclear power is expected to grow rapidly. It has been estimated that nuclear power may require 20,000 tons of stainless steel annually in five years or so, much of which will be niobium-stabilized.

## Cost and Availability

Two of the most important factors influencing niobium's future are cost and availability. Until quite recently the development of the pure metal as an engineering material was hampered by the limited availability of niobium-containing minerals, by the high cost of mineral processing, and finally, by the expense and difficulties of producing and processing metal of commercial purity.

An adequate supply of niobium minerals is now assured. Nigeria's resources of columbite are known to be very large, while the known potential reserves of pyrochlores alone—still virtually untapped—have been estimated to contain over 4,000,000 tons of niobium metal. Moreover, progress in the extractive metallurgy of niobium, as well as in the technology of concentrating the various low-grade ores from which it is derived, is helping to make niobium a very much cheaper metal.

These advances are paralleled by such developments as the large-scale electron-beam method of melting, by which technique the purest niobium so far available on a commercial scale is being produced. The Wah Chang Corporation is reported to be using this method to produce ingots of 6 in. dia. weighing 500 lb., which can be rolled down to .005 in. without annealing.

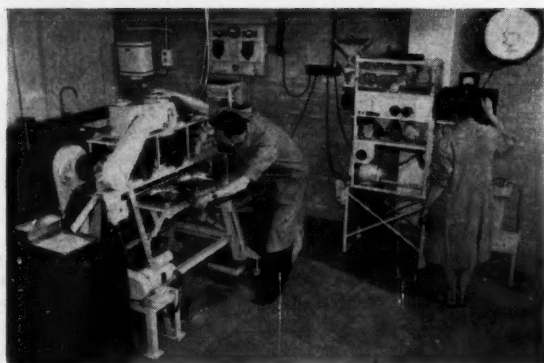
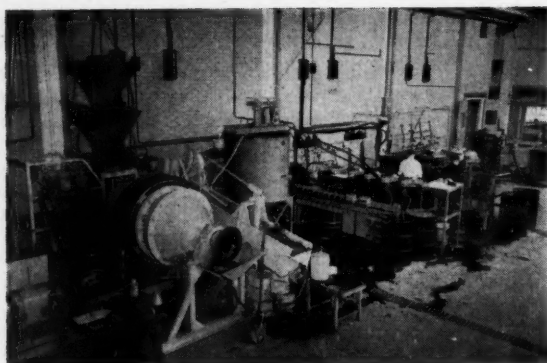
The commercial production of extrusions from niobium metal has been announced in the U.S. by Wolverine Tube, a Division of Calumet and Hecla, Inc., of Michigan, by a process developed in co-operation with Wah Chang. In the past, the presence of small impurities in the metal hindered the extrusion process. In the U.K. problems in the same field were overcome by Accles and Pollock, working in collaboration with Murex Ltd.

As an indication of the rapid improvement in niobium's competitive position *vis-a-vis* other metals, it is noteworthy that since December, 1958, the price of forging billets in 348 (Nb) stainless steel has fallen from 61.50 c. per lb. to 57.75 c. and that of bars and shapes in the same material from 72.00 c. to 67.25 c. At these lower prices they compare not too unfavourably with the cheaper types of stabilized stainless steels. Having regard to the advantages they offer, there is thus a "definite incentive" to use Nb stainless steels.

In view of experience with other metals, such as aluminium and titanium, there is every reason to anticipate that the installation of adequate production capacity, coupled with keen competition, will ensure that the increase in demand for niobium should be followed in due course by substantial economies in manufacturing costs.

Apart from providing columbite producers with a new and expanding outlet, the development of high-purity niobium as an engineering material is resulting in a more selective interest in ore with the highest possible ratio of columbite to tantalite. It seems reasonable to anticipate that this trend will become still more accentuated as the new industry gets into its stride.





**A**MONG the most conspicuous deficiencies in Britain's national research facilities has been the absence of a central ore treatment laboratory which could collaborate with the Directorate of Overseas Geological Surveys, the Atomic Energy Authority, government organizations within the Commonwealth with interests in mineral resources and the mining industry at home and overseas, in order that promising mineral deposits could be more quickly and more carefully assessed.

The provision of more adequate facilities for mineral dressing research has been advocated for several years. The subject was raised by Mr. F. B. Michell in 1952 at a meeting of O.E.E.C. Mission 54, of which he was chairman, and also in a paper which he presented to the Cornish Institute of Engineers in February of the same year. (*Trans*, Vol. VII.) In this paper Mr. Michell referred to what was being done in the United States and contrasted the facilities in that country with their absence in the United Kingdom. Emphasis was placed on the failure of the British Government to provide research scholarships in this important field.

In his plea for a fresh approach to minerals strategy, as made at the Symposium on Mineral Resources Policy arranged by the Institution of Mining and Metallurgy in September, 1955, Mr. D. A. Oliver suggested that the D.S.I.R. might consider the establishment of a national minerals research laboratory, which would be financed mainly by government, but could be fee-earning through sponsored researches for the mining companies. A similar but more detailed proposal was put forward by Dr. M. G. Fleming, reader in mineral dressing at the Royal School of Mines.

Recognizing the importance of filling this gap in our research facilities, the Council for Scientific and Industrial Research decided that laboratories for basic and applied work in mineral processing research and development should form part of the new Warren Spring Laboratory at Stevenage, Herts., to which it was intended that the staff of the Fuel

## MINERALS PROCESSING RESEARCH AT WARREN SPRING

Research Station at Greenwich should be transferred when that station closed. The official opening of Warren Spring was reported in our issue of July 3, at which period space was restricted as a result of the printing dispute. Now that more detailed consideration can be given to this most important development, it is appropriate to consider how closely the new laboratory approximates to the type of establishment envisaged at the Symposium on Mineral Resources Policy.

The first point to be noted is that the Warren Spring Laboratory is not a continuation of the Fuel Research Station at Greenwich, which is considered to have largely achieved the purpose for which it was set up. The purpose of Warren Spring, as defined by the Council of Scientific and Industrial Research, is "to carry out process research and development over a wide field not limited to particular areas of technology".

In view of the fact that current needs in the field of fuel research were now being satisfactorily catered for elsewhere, the Council decided that of the work carried out at Greenwich only two programmes should be transferred to Stevenage, namely research on the abatement of atmospheric pollution, and on the synthesis of oils and chemicals from carbon monoxide and hydrogen by the Fischer-Tropsch process. Additionally, the current research programme at Stevenage embraces two new subjects, one of which is mineral processing and the other chemical engineering research. It was further decided that the Mineral Dressing Group at Harwell should be transferred to Warren Spring.

The Warren Spring Laboratory occupies a site of 28 acres. The main building consists of a three-storey block 372 ft. long, with an administrative and library wing of three storeys, 125 ft. long. There are three pilot-scale laboratories 90 ft. x 55 ft., each provided with a 10-ton crane and having 30 ft. head room under the crane beam. The workshops and engineering stores occupy a large steel-framed building comprising six bays each 60 ft. x 30 ft., with 20 ft. head room. The site and design of the buildings will readily permit of extension to all the facilities as and when required.

Top left: A view of the interior of the mineral processing plant. Below it is part of the separations laboratory. On the facing page is a general view of Warren Spring.

The total cost of the development is approximately £620,000, in which connection it is interesting to recall that the estimate tentatively put forward by Mr. Oliver at the 1955 Symposium envisaged a capital cost of £500,000 and £200,000 annual running charges for proposed mineral dressing and process metallurgy alone. Since the mineral dressing laboratories form only a part of the facilities at Warren Spring, it might be inferred that initially it is on a rather smaller scale than was envisaged at the Symposium. On the other hand, the wider field covered at Warren Spring has resulted in the provision of a larger and more comprehensive Central Services Division than would have been necessary for a laboratory dealing only with mineral processing. This includes chemical analysis, spectrography, infra red analysis, and X-ray diffractometry. All the equipment is of the very latest type and includes, for example, an X-ray fluorescent spectrometer which should be particularly mentioned for its value in the examination of complex metal ores. In addition, there are all the more usual services such as large well equipped workshops, library, photographic section, etc. Mineral processing research should also benefit from the proximity of workers specializing in such a closely associated subject as chemical engineering research.

The aims of the division, as set out in the official brochure, are broadly identical with those outlined by Dr. Fleming at the Symposium in his proposal for a central ore treatment laboratory, namely: "To serve the mining industry at home and overseas by developing methods of beneficiation of hitherto unworked deposits, by effecting improvements in processes employed in the treatment of ores and minerals, and by developing processes for the extraction of mineral or metal products from waste or dump materials".

Dr. Fleming amplified his definition by stating that the proposed laboratory would be concerned with ore testing and the development, study and improvement of separation, concentration or extraction processes for ores and mineral products, by any suitable physical or chemical means. While employing all the methods of mineral dressing, chemical engineering and extraction metallurgy, it would not, in general, include established metallurgical operations and industrial chemical processes, the emphasis being on the production of readily saleable raw materials rather than end products. Because the laboratory would be concerned as much with the future as with the present, mineral deposits below "ore" grade would be investigated and uneconomic extraction processes of likely strategic importance would naturally find a place in the programme. These recommendations, made in 1955, appear to be an accurate description of the scope and policy of the mineral processing division at Stevenage.

The laboratories are equipped to handle most laboratory-scale mineral dressing operations such as flotation, jigging, tabling, heavy-media separation, wet and dry magnetic

separation, and high voltage separation. In the hydro-metallurgical field, facilities are available for atmospheric and pressure leaching, for fluidized-bed roasting, chlorine metallurgy, and solvent extraction. The division has a mineralogical section, but relies on the physical and chemical services division for its analytical work.

The mineral processing building is equipped with a 4-ton lift from the ground floor to the gallery to take skips and trucks containing the ore for processing.

The pilot plant facilities enable primary crushing operations to be carried out on a scale of up to  $2\frac{1}{2}$  tons per hour, and flotation plant is available for treatment of ores at rates up to 1,000 lb. per hour. Full-scale tests with radio-active tracers can be carried out.

Equipment in the pilot-scale building includes a 12 in. x 7 in. Parker primary jaw crusher (approx. 5 tons/hr.), 12 in. x 4 in. Parker secondary jaw crusher (approx.  $2\frac{1}{2}$  tons/hr.), 19 in. x 12 in. Goodwin Barsby rolls (approx. 3-4 tons/hr.) Fraser and Chalmers vibrating screen (30 in. x 12 in.), Sturtevant rotary sampler, pilot flotation plant (600 lb./hr.), Hardinge ball mill, Denver single rake classifier (8 ft. x 1 ft.), conditioner (30 cu. ft.), 6 No. 8 Denver flotation cells, 6 No. 7 Denver flotation cells,  $\frac{1}{2}$  size Wilfley table, heavy medium plant, Humphrey spiral, wet magnetic separator, mixing and conditioning unit, and a Knapp and Bates pneumatic table (27 in. x 42 in.).

In line with Mr. Oliver's suggestions at the Symposium, the national ore treatment laboratory is financed mainly by the Government through the D.S.I.R. grant, but will add to its income by undertaking sponsored research for mining companies and government bodies. The Overseas Geological Surveys are expected to be among the largest sponsors.

With such a wide range of problems from which to choose, great care has been necessary in drawing up a research programme and many discussions have been held with members of the Council of the Institution of Mining and Metallurgy, mining schools and companies, consultants, and other interested parties. To begin with about half the effort of the mineral processing division will be devoted to long-term basic research, which is expected to be concentrated initially on three main subjects, namely:

- (1) A study of grinding in the presence of additives such as surface active agents;
- (2) the application of electrochemical methods to the analysis of surfaces of minerals during flotation and a study of the kinetics of bubble attachment.
- (3) a study of the behaviour of mineral particles in a high tension field and the modification of this behaviour by various surface treatments.

Sponsored work will only be undertaken when there is a reasonable likelihood of practical success, since it is felt that a government organization should not use the country's



resources for work unlikely to be of economic value. A lower fee will be charged for sponsored work if the division is at liberty to publish the results than if the sponsor wishes them to be kept to itself. Organizations interested in the same problems will be encouraged to collaborate in joint sponsorship of investigations of mutual benefit.

How does the new laboratory fit into the general picture of minerals research in Britain and the Commonwealth? The intention is that it should be supplementary to and not competitive with other commercial, private or government laboratories. We are informed that to some extent it is replacing Camborne and the Royal School of Mines as a research centre, but Warren Spring point out that both these establishments agree that their function is essentially teaching rather than consultancy. The appointment of Dr. Fleming as a consultant to the mineral processing division at Stevenage has provided a direct link with the Bessemer Laboratory of the Royal School of Mines, and both establishments should benefit from this close association.



A section of the mineralogy laboratory

In our view, it would be unfortunate if the establishment of this new national research laboratory were to result in any diminution of the importance of continuing, and indeed extending, special work in the mining and metallurgical schools, where specialized knowledge is usually available, the more so since this is a branch of mining technology which lends itself particularly well to post-graduate work.

Our hope is that Warren Spring will come to be regarded primarily as a focal point for providing an overall picture of the research work currently being undertaken throughout the Commonwealth, and that it will succeed in exerting a helpful influence in causing new research work to be undertaken wherever it is likely to be most effectively and expeditiously carried out, its own technical resources being at the Commonwealth's disposal for fundamental work of broad common interest which is not being effectively pursued elsewhere. To a lesser extent there is also the problem of avoiding duplication in sponsored research, which, clearly, is a further benefit that can flow from the establishment of Warren Spring.

The laboratories operated by mining companies are nowadays maintained primarily for plant and process control and their value would be in no way diminished by the existence of a national laboratory at Stevenage. Commercial ore-testing laboratories maintained by equipment and

reagent manufacturers to provide a technical service for their customers are unlikely to be adversely affected, more especially as it is no part of the national laboratory's function to recommend the product of any particular manufacturer.

Many of the problems which the mineral dressing division will be called upon to investigate will, of course, be concerned with deposits overseas. In the Colonies ready-made channels exist through the Overseas Geological Surveys, through whom problems will be referred to Stevenage when they are beyond the resources of the local laboratory. Contacts with other members of the Commonwealth are available through the D.S.I.R. organization and its counterparts in the Commonwealth as well as through the mining companies, the Institution of Mining and Metallurgy, and other mining associations. Apart from these existing channels, direct contacts are being established between Warren Spring and mining companies overseas.

Finally, an Overseas Mineral Processing Advisory Committee has been set up to advise on the selection and priorities of investigations requested by colonial territories.

Inevitably one of the greatest difficulties when starting up a new research laboratory of this nature is to find men having suitable scientific or technical qualifications who have also acquired the necessary skills. In the case of Warren Spring, not only trained research workers but also men with a practical knowledge of mineral dressing are required. Recruitment is being carried out in consultation with the mining industry. Some of the trained research workers have already spent several months at the Mines Branch, Ottawa, Canada, receiving practical training while others have had the advantage of a special course provided by the Royal School of Mines. Broadening of practical experience by visits to mills overseas will continue as part of the training policy. The number of workers currently engaged in mineral processing at Stevenage is at present 35. This number will be increased as the demand for sponsored work increases.

The national mineral research laboratory at Warren Spring may be regarded as a long overdue attempt to provide in the United Kingdom adequate facilities for the long-term research effort which private enterprise alone is not in a position to undertake. The laboratory is prepared to back its ability to give value for money.

In Lord Hailsham's words: "If the venture is successful it will go from strength to strength. If it fails we shall scrap it and do something else". But there need be no thought of failure if the laboratory is successful in its primary aim of gaining the support and confidence of all the various organizations concerned in the development of the Commonwealth's mineral resources, whether government organizations or commercial firms.

By no means the least interesting development at Warren Spring is the setting up of a special Intelligence Division, one of whose important tasks will be to carry out surveys into the end uses of certain minerals and mineral products which are required as a background to the research programme. This is one more example of the improvisation that has to go on in Britain owing to the absence of any machinery for providing a continuous and comprehensive survey of user demands for metals and basic raw materials.

Adequate and up-to-date data on supply and consumption trends are of the utmost importance not only to the formulation of a national mineral resources study but also to individual mining companies who may be contemplating the development of newly discovered deposits or the installation of larger treatment plants. In the United States this essential service is most ably performed by the Bureau of Mines. So far as Britain is concerned, there is perhaps some encouragement to be derived from the growing awareness that the need exists.



# Fire-Resistant Hydraulic Fluids For Coal Mines

**A**s a result of a co-operative effort under the leadership of the U.S. Bureau of Mines, an economic fire-resistant hydraulic fluid for coal mine applications has been evolved and it is claimed that the use of this water-in-oil emulsion could mean improved safety, reduced loss of working time and increased production.

In a fact-collecting survey, undertaken in view of the increasing use of flammable hydraulic oil in mines, the Bureau of Mines established that, between 1952 and 1958/59 fires involving hydraulic equipment were investigated in 54 mines. The hydraulic oil capacity of the equipment involved was 3,046 galls. and 72.88 per cent of hydraulic oil was involved in the fires, which were traced to 96.62 per cent electrical ignition sources and 3.38 per cent other sources. It was further reported that about one gallon of hydraulic oil is consumed for every 25.2 tons of coal mechanically mined, this amounting in the U.S. to 15,000,000 galls. a year. It is also estimated that within 10 years this volume could be doubled.

From discussions between the Bureau of Mines and mine operators, workers and machinery manufacturers it was determined that a fire-resistant mine fluid should be safe, easily handled, non-toxic and economical. It should also directly replace hydraulic oil and require a minimum of hydraulic system modification.

## Water-in-Oil Emulsions

Of the various types of fire-resistant fluids commercially available, water-in-oil emulsions were considered most closely to fit the needs of mines and most of the time devoted to studying this problem has been spent on the possible development of these emulsions for mine use.

They consist of premium hydraulic oils combined with certain emulsifying agents and water by a definite procedure, the oil therein surrounding the minute water globules. While the oil acts as the lubricant, the water is the "snuffer", creating steam when the fluid is heated to ignition point and preventing combustion and fire. Loss of water by the fluid, therefore, reduces its fire resistance, though the hydraulic system continues to function.

Such emulsions may be delivered to the mine already blended by the supplier with the required percentages of oil and water, though stability of the fluid cannot be guaranteed during storage. Alternatively, drinking water can be slowly added to the oil, as recommended by the supplier, at the mine. Because it permits the concentrate to be stored outdoors and the mixing of small batches and also reduces the cost of the finished product, this latter method is considered the best possible compromise for mining applications.

The material developed has the following typical properties:—60 per cent oil, 40 per cent water; s.g. 0.9165; colour, white; neutralization No. 0.12; specific heat @ 100 deg. F., 0.68; co-efficient of expansion 0.0003; viscosity @ 40 deg. F., SSU, 2180; viscosity @ 100 deg. F., SSU, 367; viscosity @ 180 deg. F., SSU, 98.5; viscosity index 144. Preliminary evaluation in a vane-type pump under varied conditions indicated that a satisfactory performance could be expected and tests performed by Shell Research in one vane pump for varying hours and pressures but at a fluid temperature of 150 deg. F. had the following results:—

Hours	Pressure	Total Weight Loss, M.G.	
		Vanes	Ring
304	1,000	—	—
304-556	1,200	—	—
556-756	1,500	64	193

Further evaluation of the material was made by the Bureau of Mines, U.S. Steel Lubricants Testing Laboratory and by Jeffrey Manufacturing Co.

## Results of Tests

The Bureau of Mines operated the fluid in a test stand equipped with a widely used gear pump for 500 hours at 150 deg. F. and at 1,000 lb. p.s.i. and for 500 hours at 185-190 deg. F. and 1,000 lb. p.s.i. The fluid remained in good condition while that of the pump was considered satisfactory for further operation. Water loss was seven per cent of the total.

A similar type of test run by U.S. Steel for 1,000 hours at 150 deg. F. and 1,000 lb. p.s.i. showed a pump part weight loss of 0.0614 per cent—the lowest to-date with any of the low-cost fire resistant fluids. The piston heads and thrust plate were pitted slightly and the inside surfaces of the thrust bearing were fretted on the pressure side, a condition common to other fire-resistant hydraulic fluids, though this did not occur in a similar test using petroleum hydraulic oil. This surface fatigue is being investigated and other pump tests are under way.

In high pressure spray tests, using a neutral oxygen/gas flame or butane torch as an ignition source, the fire-resistance of the fluid met established standards. For example, with the fluid at 150 deg. F. and 150 lb. p.s.i. there was no ignition and no flame propagation at distances of 3 to 36 in. from the nozzle. At 3 in. there was slight ignition. Using an electric arc, there was no ignition from 18 to 36 in. In another test, with the fluid heated to 140 deg. F. and ejected at 1,000 lb. p.s.i. through an 80 deg. nozzle only intermittent flashing was noted with an oxy-acetylene torch at 18 in. and nothing at 36 in.

With full field trials arranged with a large coal company in the Fairmont field of West Virginia and with Duquesne Light Co., Harwick, Pa., using a Joy 10RU cutting machine and a Joy 5SC shuttle car respectively, overall performance was found to be good. The Duquesne Company, however, had to install an auxiliary 15 gall. tank to keep the bulk fluid temperature below the 150 deg. F. found to be the optimum for emulsions to prevent water loss.

One of the points noted at the West Virginia mine was the high degree of cleanliness found in this system. By using capped 5-gal. containers which were filled in the shop, the amount of coal and lime dust filtering or falling into the system was minimised. This is a problem which will require constant supervision when using fire-resistant fluids.

Because these fluids are not identical with oils they must be handled in a somewhat different manner and special precautions are recommended to be considered before deciding to change over from oil to emulsion.

## Machinery and Equipment

# New Ore Preparation Plant

The new Stanton ore preparation plant of the Stewarts and Lloyds Ilkeston Works was officially opened on October 1. This was the culmination of 2½ years of construction work that has cost nearly £4,000,000. Designed to process between 25,000 tons and 30,000 tons of ore per week, the plant will allow reserves of home ore to be used, which are at present unsuitable without preparation.

The iron ore is received by rail in the extensive sidings where the various ores, constituting the blend, can be assembled. From these sidings, the wagons are fed by gravity to a wagon haul which delivers them to a tippler handling them at the rate of 30 wagons per hr.

From the tippler hopper, the ores pass via rough screening feeders to the primary crusher which takes care of 800 tons per hr. The primary crusher reduces the lump ore to sizes of 6-8 in. which then joins the rough screened material and is conveyed to the secondary crushers, where it is reduced to a maximum size of 3 in.

After crushing, the ore is conveyed to the bedding plant where it is spread horizontally in piles of 6,000 tons. Later, it is reclaimed in vertical slices to ensure a uniform mixture of the various ores. The reclaimed ore then passes to the screen house where the material less than ½ in. in size is screened out and conveyed to the sinter plant stockyard. The plus ½ in. size is conveyed via the distribution bins to one of the two blast furnace plants.

The sinter material, consisting of various types of ore fines and coke fines, is assembled in blending bunkers and discharged in the correct proportions through table feeders on to a conveyor. The cooled sinter is delivered by conveyor to the distribution bunkers for discharge to the blast furnace bins. Dust extraction equipment is installed on the sinter plant at every critical point to prevent emission of dust from the plant.

### C.E.E. PRECUTTER BAR

An additional gearbox to be used in conjunction with the Anderton Shearer for the purpose of driving a rotating precutting tool has been devised at the N.C.B.'s Central Engineering Establishment, Stanhope Bretby.

The normal method of preparation applied to a longwall face, to enable the best possible haulage speed to be obtained, consists in the use of a separate chain jib coalcutter machine travelling in advance of the shearer. The jib is generally arranged to cut at about mid-seam or above to allow the release of the maximum amount of lump coal under the influence of the upward cutting picks of the shearer drum. The jib length is generally equal to twice or three times the width of the web, in which case a precut is required for every two or three shears respectively.

In the case of the new method, both precutting and shearing are accomplished by the same machine. The

restriction of the depth of the precut to the buttock width should, moreover, result in improved strata control and the removal of the accident hazard of falls of face.

The gearbox is arranged for incorporation within the length of a standard Anderton Shearer between the motor and the drum drive gearbox, so that the input shaft of the precutter gearbox serves also as an extension of the input shaft driving the Shearer Drum gear train. A bevel pinion keyed on to the input shaft drives the precutter main shaft through a train of gears. The main shaft extends through the gearbox at right angles to the direction of shear. Both shaft ends carry flange couplings on which either a L.H. or R.H. pre-cutting tool may be mounted, depending upon the normal direction of shear of the machine. The shearer may be arranged therefore to cut either from left to right or from right to left, with the precutter preparing the face in advance of the shearer drum in either case.

The gearbox body is a rugged casting, flared in at the base to allow gummings from the kerf to fall on to the panzer conveyer on which the machine travels.

### RHOKANA SWITCHES FROM BALL MILLS TO ROD MILLS

When, because of the economy drive and the expansion programme envisaged for the Mindola Shaft by the Rhokana Corporation, it became necessary to expand the mill to deal, in the first place, with 400,000 tons of ore a month instead of the 350,000 tons being handled in 1956-57, a changeover was made from ball mills to rod mills.

Under the old system the ore was put through tertiary crushers to reduce it to  $\frac{1}{8}$  in., which size could be accepted by the ball mills. In addition to the use of seven crushers, 16 double-decker vibrating screens were involved in this operation. The ball mills ground the  $\frac{1}{8}$  in. material to a fine pulp for treatment by flotation.

A detailed study of the circuit showed that the crushing plant was a serious bottleneck which would require expensive extensions to the screening and crushing units in order to handle the increased tonnage, or, alternatively the introduction of a system of rod milling. Tests in the latter part of 1957 showed that rod milling at Rhokana was feasible. They also showed that the six mills would have to be increased in size.

Work on the design of the new project was begun in 1958 and a detailed construction schedule was drawn up so that production could proceed at the normal level during the changeover period.

Under the new system the mill is charged with steel rods in place of the balls. Each rod is up to 12 ft. in length by 4 in. in dia. and weighs up to 500 lb. The rod mill receives 1 in. material, and even a small amount of rock as large as 3 in. is not a deterrent. The use of tertiary crushers and the screening plant is therefore now eliminated.

As the existing foundations were neither strong enough nor in suitable positions for the larger mills, piles were driven near to the operating units, in some cases to a depth of 25 ft. Precast foundations were then prepared outside the main building and these were rested on the piles.

The changeover operation involved the removal of an old mill, breaking down the foundations, placing the new precast concrete blocks and the installation of a new mill. This took seven days from shut down of feed to the commissioning of the new unit.

At the same time as the major scheme was developed, a changeover was also made to cyclone classifiers. In addition,

Illustrated is the gearbox mounted in a standard machine which shows the main points of operation of this development. The precut is made a short distance in advance of the main drum and above the drum centre line. It is thus situated in a position to de-stress a large proportion of the buttock for removal by the upward cutting picks of the shearer drum





all existing "white metal" bearings were replaced by roller bearings on the extended units. This reduced frictional losses and meant that no additional large drive motors were necessary.

Since the screening plant is no longer required there has been a considerable reduction of dust particles in the air at the Central Shaft, which is used as a downcast airway for ventilating air to to many working places underground at Nkana.

### GIANT WHEEL MIXES ORES

A giant wheel as high as a three-story building is the key element in a new blending and reclaiming machine designed and built by Hewitt-Robins, Inc., United States, to mix various grades of ore. The first installation of the new machine has just been completed in the American Cement Corporation's Riverside plant at Oro Grande, California. Additional installations are planned at other locations.

The rotating wheel resembles a huge Ferris wheel but instead of having seats for pleasure rides it is fitted with rugged two-ton capacity buckets which dig into stockpiled bulk materials and remove the pile at a rate of 300 to 500 tons per hr. The wheel is mounted on a carriage which moves from side to side across the storage pile and also moves forward into the pile.

As the buckets dig in, they remove a cross-section containing a portion of each of the various grades of materials in the pile. This is easily accomplished because the pile has been systematically built up of alternate layers of material varying in richness, chemical analysis and size of particles. As the material is withdrawn from the pile, it is dumped into a large hopper which discharges to a conveyor system.

### VACUUM ARC-MELTING FURNACE

The General Electric Co. Ltd., in association with Vacuum Industrial Applications Ltd., have received an order from the National Physical Laboratory for a 2-litre vacuum arc-melting furnace. The furnace will be used for melting and casting refractory metals such as titanium, niobium, molybdenum, etc.

The furnace may be used for melting by either the consumable or non-consumable electrode process. In the former case the ingot is formed from an electrode of the parent metal which is fed progressively into a molten pool in the mould; non-consumable electrode melting is effected by using a tungsten electrode to strike the arc into which the charge is fed as small particles.

The power is being supplied by a 2,000-amp., 40-volt germanium rectifier unit. The rectifier output is controlled by means of a saturable reactor connected in the primary side of the rectifier transformer enabling the output current to be varied from 500 amp. up to 2,000 amp. The power unit has a short time overload capacity of 2,500 amp.

A two-stage pumping system is provided comprising an oil booster-diffusion pump backed by a rotary pump. The working chamber pressure is 0.1 microns Hg. and the pumping speed is sufficient to maintain this pressure against gas evolution from the electrode and molten pool.

## Technical Briefs

### New Flocculating Agent

A new flocculating agent in granular form has been developed by Cyanamid International scientists. In plant and field trials, this high molecular weight polymer has consistently out-performed other synthetic and natural polymers as a filtration and settling aid for solid-liquid separations.

Known as Superfloc 16 flocculant, the product is particularly effective in thickening operations for increasing settling rates and overflow clarity. In settling acid-leached uranium ore at a Canadian CCD (counter-current decantation) plant, for example, 0.06-0.107 lb. of Superfloc 16 per ton of ore have provided the same settling rate, overflow clarity and underflow fluidity and density as 0.11 lb. per ton of the previously used product.

Other plant trials at Colorado plateau uranium operations, which also use CCD for solid-liquid separation, have shown that Superfloc 16 decreases soluble uranium losses by increasing underflow densities 5-7 per cent. Dosages of Cyanamid's new flocculant are the same as or less than those of the regularly used flocculant.

A high bulk-density product, Superfloc 16 has a molecular weight of the order of several million. Its essentially dust-free granular form makes it easy to feed, wet and dissolve. Produced at Cyanamid's Princeton, New Jersey, plant, the commercial product is the result of a five-year research programme.

In addition to uranium mining, Cyanamid expects its new flocculant to find wide application in the clarification of coal plant effluents as well as in other areas of the mining industry where solid-liquid separations are a problem. It may also be used to treat water and suspensions of sewage, industrial wastes and chemical precipitates.

### STEEP ROCK'S CONCENTRATOR FOR IRON ORE

Perhaps the most interesting feature of the Steep Rock Iron Concentrator recently described in *World Mining*, is the use made of gravity concentration. In fact the whole of the 350 tons per hour is handled solely by making use of the differential in specific gravity.

Obviously, good washing and slime separation in spiral classifiers and cyclones is an important step in the flowsheet and at present the most challenging part of the flowsheet involves treating the -200 mesh material since losses are considerable in this size range.

The choice appears to be limited to either flotation or roasting followed by magnetic separations but it appears that no satisfactory suggestions have been made to date. Flotation investigations are in progress, however.

Returning to the flowsheet, H.M.S. is employed on material larger than  $\frac{1}{2}$  in., reamer jigs on the intermediate size and spirals for the finest material after desliming in cyclones. The reamer jig uses a complex motion, combining a  $\frac{1}{2}$  in. stroke at 150 r.p.m. and a  $\frac{1}{4}$  in. stroke

at 400 r.p.m. and is provided with  $\frac{1}{2}$  in. balls on a  $\frac{1}{2}$  in.  $\times$  lin. punched plate deck. The cyclones deslime at 200 mesh and consist of Krebs two-stage units.

This cyclone underflow passes to a surge tank-cum-thickener and the underflow to Humphreys spirals comprising rougher and cleaner units.

In order to improve the efficiency, the cyclone underflow will be treated directly in a  $15\frac{1}{2}$  pocket Doorco jet sizer and the thickener only used for water reclamation of the overflow.

Three products will be produced by this sizer, a concentrate, a spiral feed, and a tailing. In other words, the greater part of the coarser concentrate consisting of +80 mesh material can be withdrawn due to the effect of the density differential and will have a grade of 57 per cent Fe. 49 per cent will be recovered in this way.

The use of this preliminary treatment will reduce the load on the spirals very considerably and will in fact reject nearly 15 per cent as a tailing at the same time. As a result it is expected that the recovery in the spirals will be 70 per cent and the concentrate grade 57.5 per cent Fe.

### TREATING CERTAIN COPPER ORES

The segregation process devised in 1923 actually used in the pilot scale in Rhodesia and by the Union Minière de Haut Katanga for a short time has been the subject of recent research by the U.S. Bureau of Mines. The process consists of heating the oxidized ore with a reducing agent and a halide salt at about 700 deg. C to produce metallic copper, which may be recovered by ammonia leaching or by flotation.

Both laboratory and small pilot plant tests appear to indicate that the process has merits for treating mixed oxide-sulphide ores and that ore having calcareous, siliceous or bentonitic gangue could be processed with good copper recovery whilst the process was demonstrated to be technologically feasible. Direct operation costs are considered to possibly range from \$2.85 to \$3.00 per ton depending on whether coal or coke were used as the reducing agent.

Tests carried out under varying conditions indicate about 1.5 per cent of salt and 0.5 to 1.0 per cent of coke was required for ore carrying hematite or calcite but siliceous ores required less. The size of the salt particle did not appear very critical but the size of the coke used needed more control. Segregation varied with the temperature and the time, at least 60 minutes was required for good segregation at 700 deg. C whereas only 15 minutes sufficed at 800 deg. C.

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Results published in Russia indicate that a high rate of dissolution of gold can be obtained using modified flotation cells and it is suggested that the rate increases faster than the increased power-air input would indicate.



# MINING MISCELLANY

Some preliminary exploration of phosphate deposits near Homs in Syria is reported to have been carried out. Tests by Soviet experts are reported to have shown that the iron bearing deposits at Rajon near Aleppo contain a high proportion of iron oxide. Prospecting for iron and other minerals is also being carried out in the Lattakia Mohafazat.

The High Authority of the European Coal and Steel Community has announced that it will not subsidize pithead coal stocks amassed after July 31 of this year in Western Germany because of lack of funds. The Community was granted \$7,000,000 by its members to subsidize stocks, but most of that money had been paid out by June 30, 1959.

A report published in Budapest states that Hungary proposes raising her coal output to 27-29,000,000 tons by 1965, compared with 24,200,000 tons in 1958. This is part of Hungary's second five-year plan for 1961-1965, which further aims at achieving four times as much mechanised loading as in 1958. The plan also mentions that uranium deposits should continue exploitation, and processing of uranium ore is foreseen.

The National Coal Board scholarships in mining and other branches of engineering have been awarded during 1959 to 20 young men in the mining industry and 26 boys outside it. The scholarships cover the whole cost of education and carry a maintenance allowance, which may amount to £355 a year according to the university attended, irrespective of family income. There are extra allowances for married men and men with dependants.

An article published recently in the Soviet magazine *Ugol (Coal)* claims that coal production in the Communist countries has increased from 33 per cent, in 1953, to 51 per cent, in 1958, thus exceeding half the total coal production of the world.

The Governor of the Province of Catamarca, Argentina, Sr. Juan Manuel Salas, has signed a contract with the National Atomic Energy Commission for the exploration and exploitation of deposits of radioactive minerals in that province. Exploration in Catamarca was first started in 1954 and soon confirmed the existence of deposits. The most important areas are considered to be Tinogasta and Fiambala, especially at Chaschuil, Sierra Narvaez, and Cachiguayo. Deposits are also reported to have been discovered in the region of Hualfin, Bella Department, west of Santa Maria, Sierra Ambito, and Ancasti.

Copper output at Willroy Mines, Canada, is rising states *The Northern Miner*, firstly because the copper content of the main orebodies is increasing with depth, and secondly because the new straight-copper orebody recently developed in the eastern section of the property is now coming into production. The mill is currently handling 1,100 tons daily, of which about 100 tons is from stope preparation work in the new No. 6 copper zone, averaging about 3 per cent copper. By the end of 1959, ore

from this source will be increased to about 200 tons daily. While copper will probably assume more importance in the overall Willroy picture, the company will continue to produce zinc in quantity. During the first six months of 1959, output was over 16,000 s. tons.

British, Chinese, Belgian, Soviet, Polish and German mining experts have been in Budapest for a meeting of the International Mining Committee. The committee is preparing for a world mining congress to be held in Czechoslovakia early in 1960.

An Australian company claims to have manufactured the largest diamond drill in the world. The plant, which has been assembled and tested, will be capable of drilling to a depth exceeding 10,000 ft., and will drill holes 2½ in. in dia. The drill has been constructed for Kalgoolie Southern Gold Mines, which is drilling to locate a southern extension of the Boulder beds which contain the mines of the Golden Mile.

The Government of Burma, which is a member of the International Atomic Energy Agency, has decided to establish an atomic energy centre in Burma. The building of the centre and a nuclear radiation laboratory on a 100-acre plot, is now in progress. The nuclear laboratory will serve as the first main laboratory for the handling of radio isotopes. A number of geologists have been engaged by the centre and a co-ordinated effort is being made with other geologist groups in Burma to search for uranium ores.

The South Australian Government will commence an intensive geological and geophysical survey of a portion of the Great Artesian Basin early in 1960, as part of the search for oil. It is reported that a large, low-grade deposit of iron ore has been mapped and drilled on Tiverton Station, 20 miles south-east of Yunta, on the Peterborough-Broken Hill railway. The occurrence is estimated to contain 100,000,000 tons of openpit material, but its utilization depends upon the successful development of a process to recover the finely disseminated iron mineral. Drilling has been continued at Radium Hill and ore has been found at 2,500 ft. vertical below surface, which is the deepest lode intersection on the field. In the South Hill area, drilling has disclosed high grade uranium ore several hundred feet below surface, and this is expected to make a useful contribution to the Radium Hill production of uranium oxide.

The Madhya Pradesh Government proposes to set up a Mineral Development Corporation as part of India's third Five-Year Plan. Though the State is unusually rich in mineral wealth, the revenue from the royalty paid by private enterprise is just a little over 10,000,000 rupees. The State Government is also working on a scheme to acquire partnership in all projects of the Government of India for exploitation of mineral resources in the State. A sum of Rs.80,000,000 to Rs.1,000,000,000 is expected to be provided for mineral development in the State's Third Plan.

The American Zinc Co. of Tennessee, a wholly-owned subsidiary of American Zinc, Lead and Smelting Co., announces that the Grasselli mine at New Market, Tennessee, is being reactivated and it is expected to be in full production within the next couple of months. The property, which has been idle since the end of 1957, is expected to have an annual production of some 9,000 tons of 60 per cent zinc concentrates.

Jefferson Lake Sulphur Co. has exercised an option to acquire a major deposit of chrysotile asbestos in California from American Asbestos Co. of New York. The property is near Stockton, and exploration work by Jefferson Lake has proved about 15,000,000 tons of commercial ore, more being indicated. Jefferson Lake plans to install mining equipment and a mill with a capacity for processing 2,000 tons of ore a day.

According to a recent statement by the Hon. Paul Hasluck, M.P., Minister for Territories, the production of minerals in Australia's Northern Territory in 1958-9 (excluding Rum Jungle uranium and building and construction material) was valued at £4,155,000. The mining of wolfram and scheelite ores, which were of major importance in recent years, has now virtually ceased, but uranium and manganese are coming into prominence. Mr. Hasluck went on to say that the re-opening of the government battery at Tennant Creek in October, 1958, had boosted small-scale mining in that area. During the last twelve months the battery crushed 5,572 tons for a return of 3,822 oz. of bullion.

Mr. S. Goren, chairman and general manager of Development Areas Industries Ltd., the Israeli firm which is working in co-operation with the Ministry of Commerce and Industry and the Federation of Labour, has confirmed that the company plans to construct a copper refining plant in Ashdod, with a monthly capacity of 50 tons, which will supply local requirements. The company, which plans about 20 plants, at a cost of £10,000,000, has already attracted the investment of foreign capital and know-how. Timna copper ore and scrap ore will be used in the first plant and it is not intended to use the electrolytic method until a later stage.

## PERSONAL

Mr. Herbert Slack has been appointed to the board of Kelvin and Hughes (Industrial) Ltd., as sales director. Mr. Slack was formerly technical sales manager.

Mr. F. H. Beasant has been appointed Deputy Manager of the Traction Division of the Brush Electrical Engineering Co., a member of the Hawker Siddeley Group.

Mr. G. B. Elphicke has been appointed deputy chairman and managing director of the Fawcett Construction Co., Ltd., in place of Mr. A. A. Parrott, who has resigned after 50 years service with the company. Mr. G. Ball, A.M.I.C.E., has been appointed the London Manager.

Mr. Frank Bower, C.B.E., president of the Association of British Chambers of Commerce, and Mr. M. D. Oliphant, M.B.E., T.D., president of the National Union of Manufacturers, have been elected to the Board of British Overseas Fairs Ltd.

Wickman Ltd., announce the appointment of Mr. R. J. Dixon as director and general manager of their Machine Tool Manufacturing Co.

Mr. John F. Gates, regional director for Central and Southern Africa, Cyanamid International, has been appointed regional director Africa.

The National Coal Board announce that Mr. C. F. Dutton, head of By-Products Branch of Marketing Department will be retiring at the end of January, 1960, and is to be succeeded by Mr. A. Bradley, previously sales manager of Chemical Engineering Wiltons Ltd., a subsidiary of Simon-Carves Ltd.

Mr. John Harrison has been appointed managing director of Atlas Copco (Great Britain) Ltd., in the place of Mr. J. C. Greig, who has resigned.

Following the resignation of Mr. J. C. Greig, Mr. John Harrison, A.M.I.M.E., has been appointed managing director of Atlas Copco (Gt. Britain) Ltd. Mr. Harrison, who was formerly an Area production manager in the N.C.B.'s South-Western division, joined Atlas Copco in 1953. He was managing director of the group's Cyprus company until 1957, and subsequently managing director of the group's New Zealand company. He returned to this country last June as deputy managing director of Atlas Copco (Gt. Britain), a sales company concerned primarily with sales in the U.K. and Commonwealth.

#### COMPANY NEWS

R. H. Neal & Co., Ltd., mobile crane manufacturers announce the signing of contracts with the Chinese People's Republic for more than £300,000. These contracts are for standard mobile cranes, of 6 and 15 tons capacity (British rating) and will probably be used in various ports. The order is believed to be the largest placed by the Chinese authorities for this class of equipment anywhere in the west of Europe, and the company looks upon the market as one offering long-term prospects.

As part of the course entitled "Nickel Survey" which is being held at Hatfield Technical College, Herts., Henry Wiggin & Company, Ltd., have been invited by the College Department of Mechanical and Production Engineering to stage an exhibition. The exhibition, which will be open from November 17-19, will not only be an integral part of the course on nickel and its alloys, but will be of great interest to local industry.

Hilger & Watts Ltd., have acquired the whole of the issued share capital of The Infra-Red Development Co. Ltd., of Welwyn Garden City.

Contracts worth over £50,000 have been placed with Taylor Woodrow (Arcon) Ltd., by Ransomes and Rapier Ltd., for the supply and erection of three steel-framed buildings at their Ipswich works. One of the buildings is 90 ft. high, and specially designed to house two 60-ton cranes. This will be a heavy fabrication shop for the manufacture of the largest type of excavators, including

the 1,850-ton walking draglines, which, with booms up to 303 ft. and carrying buckets of up to 40 cu. yds., are the largest dragline excavators in the world.

The name of Synthetic Carbon & Engineering Co., Ltd., has been changed to Morgan Components Ltd., in order to make clear the association between The Morgan Crucible Co., Ltd., and Synthetic Carbon and Engineering Co., Ltd.

Cable Belt, Ltd., of Inverness claim that their recent shipment of additional equipment to Coal Cliff Collieries Pty. Ltd., of Australia, will make the Coal Cliff cable belt the longest single stage conveyor with one driving unit in the world. About a year ago Cable Belt Ltd., supplied a two mile long rope driven conveyor 42 in. wide belt for this colliery, and this has now been extended to 2½ miles in length.

The Bestwood Co. Ltd., announce that they have concluded a licence agreement whereby their subsidiary company, Plowright Bros. Ltd., obtain from Klockner - Humboldt - Deutz, A.G. of Cologne the exclusive manufacturing rights in Great Britain of the Humboldt patent "sink and float" coal washing plant. The Coal Preparation and Carbonization Division of Plowright at London, will be dealing with all matters in connection with this process.

A new steel plant for Ecuador, the first in that country, is the objective of a provisional contract negotiated between Koppers Co., Inc., and Universal Mineral Resources, Inc., of New York. The plant, which would employ the recently developed Strategic-Udy process, would utilize titaniferous-iron beach sands available in Ecuador augmented by iron ore imported from Peru. Under the new contract, Koppers will proceed with the design and construction of the plant upon the completion by Universal Mineral Resources of several intermediate steps, including arranging for a continuing supply of raw material, establishing sufficient natural gas reserves for power generation, and continuing smelting tests on South American ore.

A new company, known as Vitro Idaho Minerals Corp., has been formed to develop and mine Western Fluorite Mining Co. uranium properties in the Stanley, Idaho, area and to explore and develop new mining properties in Idaho and the Pacific Northwest. The company will have main offices in Salt Lake City. It is owned 51 per cent by Vitro Minerals Corp. and 49 per cent by Western Fluorite.

#### COMING EVENTS

The third general meeting of members and associates of the Cornish Institute of Engineers will be held at the School of Mines, Camborne, on November 20, at 7.15 p.m. Mr. R. C. A. Hooper will give a lecture entitled "Current Mine Surveying Practice".

The First International Pipes and Pipelines Exhibition, sponsored by the Journal "Pipes and Pipelines," will be held at Earls Court, London, between May 30 and June 2, 1960. Full details may be obtained from the organizers, Scientific Surveys Ltd., of London.

At the general meeting of the Institution of Mining and Metallurgy to be

held on December 17, the subjects for discussion will be the two papers published in the November *Bulletin*. On January 21, 1960, the subjects will be "Serial gravity concentration, a new tool in mineral processing" by J. H. Harris, and "Use of moving bed ion exchange in the recovery of uranium at Can-Met Explorations, Ltd., Blind River, Ontario", by P. D. R. Maltby. Both these papers will be printed in the December issue of the *Bulletin*.

A symposium on Pilot Plants in Metallurgical Research and Development, organized by the National Metallurgical Laboratory of the Council of Scientific and Industrial Research, Jamshedpur, India, will be held early in February, 1960. The Director of the Laboratory requests that abstracts only, of papers which it is intended to submit, may be sent to him as soon as possible.

A Travelling Bursary for a study tour of Swedish mines, established by the Atlas Copco Organization in collaboration with the Swedish Mining Association, will be awarded in 1960. The Bursary is open to mining graduates, from any country, with at least three years' experience. The tour, of six weeks' duration, will be in March-April, 1960.

Last year Turner Brothers Asbestos Co. Ltd., a member of the Turner and Newall Organization, commenced production at the south block of the company's new factory at Hindley Green, Lancs. The opening of this block marked the completion of a £4,000,000 development project launched in 1947. The factory employs 1,900 people in the area and is one of the most important industrial developments in Lancashire since the war. To commemorate its inauguration an illustrated brochure has been published containing comprehensive details of the facilities and products of the new factory.

#### LEAD AND ITS USES

On October 26, at the Royal Society of Arts, the Lead Development Association showed the premiere of its 16 mm. film, "Lead, the Enduring Metal". Produced in full colour with spoken commentary, the film is designed to offer general information on lead to non-technical audiences. In its 28 minutes of running time it briefly traces the history and ancient usage of the metal, its geographic occurrence in the world, with thumbnail sketches of how it is mined, smelted and refined.

The main sequences demonstrate the versatile role played by lead in the modern world and its various applications, including sheet and pipe in building; as compounds in paints; in grids and oxides for storage batteries, in typematerials and solder; for electric cable sheathing and as a constituent of glass. Attention is also drawn to its well-known ability to resist corrosion and, topically, some emphasis is placed on lead's power to protect against harmful radiation hazards, with particular reference to hospital and atomic energy plant and equipment. The closing sequence suggests that further new uses for lead will evolve as scientific discovery progresses. Copies of this film, which, we understand, is to be followed by others of a more specialized kind, can be borrowed, free of charge, on application to The Lead Development Association, 18 Adam Street, London, W.C.2.



## Metals and Minerals

# Canada's New Uranium Plan

Following its failure to persuade the United States to continue buying large quantities of Canadian uranium when current contracts expire in 1962 and 1963, the Canadian Government has announced a plan to "stretch out" deliveries of uranium to the U.S. and Britain until 1962 and 1963. Price and quantity will remain unchanged.

A feature of the plan is that the Canadian Government, assisted by advance payments from Britain and the U.S., will make advance payments of \$2.50 per lb. on deliveries made during the period of deferment, these being in effect subsidies for deferring delivery. In order to keep at least part of the producing industry in healthy condition, the government will also sanction inter-company arrangements such as mergers and buying up of contracts.

It has long been apparent that the demand for uranium was rising too slowly to absorb the very rapid rate at which output in Canada, South Australia, the U.S., and other Free World countries has been expanded. Producers have been shielded, however, from the immediate consequences of over-supply by the existence of long-term contracts with the U.S. Atomic Energy Commission and the U.K. Atomic Energy Authority through the Combined Development Agency and the Canadian Government's Eldorado Mining and Refining Co. It was generally expected, therefore, that the industry would have a further breathing space before having to face the chill wind of over-supply without the protection afforded by large government contracts at assured prices.

Canadian producers hoped that the Atomic Energy Commission would take up its options to buy additional Canadian uranium when present contracts expired, but the A.E.C. has formally announced that these options will not be exercised.

Even in the case of a conventional fuel, such as coal or oil, there is no accurate yardstick for the reliable projection of future demand, as is all too clearly indicated by the vast stocks of unsold coal still piling up in Britain and other Western countries. It is perhaps not surprising, therefore, that in an entirely new industry such as nuclear power, earlier estimates of short-term requirements should have proved wildly over-optimistic. The fact remains that both the U.S. and U.K. Governments are heavily over-bought. The U.K.A.E.A., through its existing agreement with the Combined Development Agency and its two contracts with Eldorado, is believed to have enough uranium on contract to last until the late 1960's. The U.S. is in a broadly similar position and, so far as its foreign suppliers are concerned, is in the further difficulty of having its own domestic mining industry to consider—an obligation which it will certainly not be allowed to forget. This sorry situation can fairly be described as a striking example of the consequences of government buying, even when it is recalled that without the existence of numerous government contracts, the phenomenal expansion of Free World mine production could not have been achieved.

There are various reasons for the existing uranium glut. In the first place, the development of a large world market for uranium has been unexpectedly slow. As recently as 1957, it was anticipated that the U.K. and the Euratom countries alone would require between 20,000 and 22,000 tons of natural fuel, or its equivalent in enriched uranium, by 1967. This is equivalent to some 25,500-27,000 tons of uranium oxide. The Euratom programme, however, has been reduced to a mere 2,000 megawatts from 15,000 as originally scheduled, while the U.K. programme has been cut down to the installation of only 5,000 megawatts of nuclear capacity by 1966 instead of 6,000 megawatts by 1965.

At the same time, the increasing efficiency of nuclear engineering points to higher operating efficiencies with consequent savings in the consumption of uranium oxide. Whereas the Bradwell, Berkeley and Hunterston stations—the first to be ordered by the Central Electricity Generating Board and by the South of Scotland Electricity Board—may be expected to use about 1,040 tons of uranium oxide per 1,000 megawatts of installed capacity, Hinkley Point will require only about 440 tons (in the form of uranium metal) to produce 500 megawatts, while the later stations may use as little as 770 tons per 1,000 megawatts.

In view of the fact that the Canadian and South African producers started the extraction of uranium at the express and urgent request of the U.S. Government (and, indeed, of the U.K. Government), it might be contended that there is a moral obligation to look after an industry which has become of major importance to these two developing countries. Indeed, Canada's young uranium industry, selling its product primarily to Washington through the Canadian Government, proved the Dominion's leading metal producer with a value of \$290,000,000. Canadian producers still have approximately \$1,000,000,000 of business on hand from the U.S. and Britain.

The continued expansion of South African production has already been limited by the ceiling of 6,200 tons of uranium oxide a year, imposed in 1958. Understandably, in the existing circumstances, the U.K. and U.S. Governments would like to see Canadian production limited to the lower cost bulk producers with large tonnages available for future needs.

The new plan is designed to tide the industry over the period in which supply continues to exceed demand, but it will undoubtedly result in the closing down of certain mines.

So far it has been unenthusiastically received by the industry, which had expected better things from the Canadian Government than its acquiescence in this stop-gap plan. Since the attitude of the Opposition may be equally unfavourable, the political consequences might be considerable.

It remains to be seen whether the C.D.A. will attempt to limit its com-

mitment in South Africa any further by a similar lengthening of existing contracts.

So far as the long-term outlook for uranium is concerned, there is certainly nothing in the present situation to invalidate the conclusion reached in the analysis published in our issue of January 30, 1959, namely that during the period 1959-64 an excess supply may be expected to build up, which should, however, be absorbed by 1970 at the latest as civilian demand continues—assuming, of course, that there is no steep fall in the level of military requirements. In the U.S. alone the demand for military and research reactor purposes is believed to be in the region of 32,000 tons of uranium oxide a year.

## NEW ZINC-BASED ALLOY

The American Zinc, Lead and Smelting Co. and Hydrometals have signed long-term agreements for mining, milling and production of a new zinc-based alloy, composed of titanium, copper and zinc. One agreement provides for the casting on a semi-continuous base of 8,000 lb. ingots, which will be rolled or extruded by the Dow Metal Products Co., Madison, a division of the Dow Chemical Co. Mr. Howard I. Young, president of the American Zinc Co., claims that the alloy, known as Hydro-T-Metal, will create "very important new markets for zinc-based sheet metal that will benefit the entire zinc industry."

Under a second agreement the two companies will establish a joint venture to develop and exploit mineral resources and mining and milling facilities of the Peru Mining Co., Silver City, New Mexico, a wholly-owned subsidiary of Hydrometals not operated for the past three years because of low zinc prices.

## MONTECATINI ALUMINIUM

A new plant for the production of aluminium to meet the Italian domestic market requirements for many years is to be built by the Montecatini Co., of Milan.

In a \$6,000,000-\$6,500,000 barter transaction, Reynolds Metals Co. are to deliver 400,000 tons of bauxite from Haiti to the U.S. Government stockpile in 1960. The bauxite will be exchanged for U.S. surplus high protein wheat which will be sent to Haiti.

West Germany produced 110,270 tons of aluminium in the first nine months of this year. This was an increase of 4.7 per cent over the comparable period of last year. Over the same period of 1959 West German industries making aluminium goods produced 135,920 tons of semi-manufactureds, an increase of 10.2 per cent, while output of aluminium castings rose by 8.3 per cent to 56,730 tons.

## FIRM PLATINUM MARKETS

The recent hardening tendency noted in free platinum prices has continued. Although demand has not shown any noticeable broadening, there is not a great deal of material offering at the present time, especially as Russia does not appear to be pressing sales. In the circumstances buyers are having to pay rather higher prices to secure supplies. Russia has also withdrawn virtually as a seller of palladium.



In the U.S. the supply situation continues to be tight, although there is no evidence of any important pick-up in consumption or demand. Primary sellers are still adhering to their officially advertised asking rates of \$77.00/80.00 per troy oz., depending on quantity. Dealers on the outside market are keeping their own offerings around the same level.

#### ENCOURAGING MAGNESIUM PICTURE

The outlook for the magnesium industry in the U.S. continues to be generally favourable. On the basis of per-

formance in the first six months, together with continued improvement during the first two months of the third quarter, it is now expected that the total 1959 output of primary magnesium ingot will equal that of 1958, and that mill shipments will reach a total volume substantially above last year's, and possibly second only to the peak year 1956. In support of this prediction, the Magnesium Association has released data showing increased primary production for July and August, with mill shipments of wrought magnesium products for August reaching the highest point in 27 months. Ingot demand is still running ahead of production.

a demand for copper may arise which it will be difficult to satisfy if the copper strike continues and, should this prove to be the case, prices may jump up very sharply. The situation in the U.S. strike shows no sign of betterment although a number of meetings are scheduled between some of the companies and the Unions concerned.

#### TIN AROUND £800

The tin market has advanced owing to better demand in the U.S. following the return of the steelworkers and also to a continuation of the good demand elsewhere. This state of affairs has apparently led the Buffer Stock Manager to raise his selling price for cash tin and some quarters expect that a further rise is imminent. In the U.K. stocks in official warehouses showed a decrease of 91 tons for the week and the contango which was established shows signs of disappearing. This trend may continue as the price of tin in Singapore becomes nearer to the London quotations.

On Thursday the Eastern price was equivalent to £811½ per ton c.i.f. Europe.

#### ZINC DISTURBED BY BRITISH STOCKPILE RUMOURS

Both the lead and zinc markets have not maintained their recent strength as there appears to be more current period lead on offer, but some people consider that this is a temporary phase and that the recent rise in quotations will be resumed in the not too distant future.

The zinc market has been disturbed by rumours that the British Government are preparing to release the approximately 9,000 tons of metal, which they are known to have for disposal, but an announcement to the effect that no sales had been made and that a public announcement would be forthcoming if the metal were to be put up for tender, has caused a steadier undertone.

The American Zinc Institute's figures for October show that production increased slightly to 63,938 s.tons, whilst shipments increased slightly more to 65,723 s.tons and stocks at the end of October fell slightly from 193,036 at the end of September to 191,251 at the end of October. The latest figures for the O.E.E.C. countries show that in the case of lead, production in September reached 53,613 tonnes as compared with only 42,714 tonnes in the previous month, whilst the zinc production amounted to 70,789 tonnes in September as compared with 71,975 tonnes in August.

Closing prices are as follows:

	Nov. 5		Nov. 12	
	Buyers	Sellers	Buyers	Sellers
<b>COPPER</b>				
Cash	£259	£260	£259	£259½
Three months	£247½	£248	£247	£247½
Settlement		£260		£259½
Week's turnover	9,950 tons		12,500 tons	
<b>LEAD</b>				
Current ½ month	£74½	£74½	£71	£71½
Three months	£74	£74½	£71½	£72
Week's turnover	8,950 tons		10,675 tons	
<b>TIN</b>				
Cash	£793½	£794	£798½	£799
Three months	£797	£797½	£798½	£799
Settlement		£794		£799
Week's turnover	910 tons		2,615 tons	
<b>ZINC</b>				
Current ½ month	£93½	£93½	£96	£96½
Three months	£89½	£90	£90	£90½
Week's turnover	5,000 tons		4,875 tons	

## COPPER · TIN · LEAD · ZINC

(From Our London Metal Exchange Correspondent)

During the last week the situation for the four metals has shown very little change except that in the case of tin the price at which the Buffer Stock Manager is prepared to sell has apparently been raised.

#### SQUEEZE ON U.S. COPPER PRICE GROWS

The copper market retains its firm undertone and with stocks in official warehouses showing a further decrease of 1,050 tons, the backwardation has shown a tendency to increase. Demand outside the U.S. has remained at a satisfactory level and very little surplus copper is now available for shipment to the U.S. with guaranteed December arrival: this deadline is still in being as

the majority opinion is that the dockers' strike will recommence after Christmas.

In the U.S. the copper shortage is becoming more apparent and dealers are asking 40 c. per lb. or more for material for prompt delivery and with only a very slight discount applying to material for December arrival. Those producers who still have copper to sell have raised their price to 33 c. per lb. and in conformity with this the Belgians have raised their price to approximately 31½ c. per lb. Antwerp or New York, duty for buyers' account. The scrap intake price has also been raised to approximately the same level and now stands at 27 c. per lb. for No. 2 Scrap.

With the confirmation of the Taft-Hartley injunction and the return to work in the U.S. of the steel workers,

## LONDON METAL AND ORE PRICES, NOV. 12, 1959

### METAL PRICES

Aluminium, 99.5%, £180 per ton  
Antimony—  
English (99%) delivered, 10 cwt. and over £190 per ton  
Arsenic, £400 per ton  
Bismuth (min. 1 ton lots) 16s. lb. nom.  
Cadmium 9s. 0d. lb.  
Cerium (99%) net, £16 0s. lb. delivered U.K.  
Chromium, Cr. 99% 6s. 11d./7s. 4d. lb.  
Cobalt, 14s. lb.  
Germanium, 99.99%, Ge. kilo lots 2s. 5d. per gram  
Gold, 250s. 0d.  
Iridium, £23/£25 oz. nom.  
Lanthanum (98%/99%) 15s. per gram.

Manganese Metal (96%/98%) £245/£250  
Magnesium, 2s. 0d./2s. 3d. lb.  
Nickel, 99.5% (home trade) £600 per ton  
Osmium, £21/£23 oz. nom.  
Osmiridium, nom.  
Palladium, £8 12s. 6d.  
Platinum U.K. and Empire Refined £28 10s. oz.  
Imported £27½/£27½  
Quicksilver, £72 ex-warehouse  
Rhodium, £41/£45 oz.  
Ruthenium, £18/£20 oz. nom.  
Selenium, 50s. 0d. per lb.  
Silver, 80½d. f. oz. spot and 80d. f'd  
Tellurium, 18s. lb.

### ORES AND OXIDES

Antimony Ore (60%) basis .. .. . 19s. 6d./20s. 6d. per unit, c.i.f.  
Beryl (min. 10 lb. unit BeO) .. .. . 225s./235s. per 1. ton unit BeO  
Bismuth .. .. . 30% 5s. 0d. lb. c.i.f.  
20% 3s. 3d. lb. c.i.f.  
Chrome Ore—  
Rhodesian Metallurgical (semifriable) 48% (Ratio 3:1) .. .. . £15 15s. 0d. per ton c.i.f.  
" Hard Lumpy 45% (Ratio 3:1) .. .. . £15 10s. 0d. per ton c.i.f.  
" Refractory 40% .. .. . £11 0s. 0d. per ton c.i.f.  
" Smalls 44% (Ratio 3:1) .. .. . £14 0s. 0d. per ton c.i.f.  
Baluchistan 48% (Ratio 3:1) .. .. . £11 15s. 0d. per ton f.o.b.  
Columbite, Nigerian quality, basis 70% combined pentoxides (Ratio 10:1).  
Nb<sub>2</sub>O<sub>5</sub>.Ta<sub>2</sub>O<sub>5</sub> 165s./170s. per 1. ton unit c.i.f.  
Fluorspar—  
Acid Grade, Flotated Material .. .. . £22 13s. 3d. per ton ex. works  
Metallurgical (75/80% CaF<sub>2</sub>) .. .. . 156s. 0d. ex. works  
Lithium Ore—  
Petalite min. 3½% Li<sub>2</sub>O .. .. . 40s. 0d./45s. 0d. per unit f.o.b. Beira  
Lepidolite min. 3½% Li<sub>2</sub>O .. .. . 40s. 0d./45s. 0d. per unit f.o.b. Beira  
Amblygonite basis 7% Li<sub>2</sub>O .. .. . £25 0s. per ton f.o.b. Beira  
Magnesite, ground calcined .. .. . £28 0s./£30 0s. d/d  
Magnesite Raw (ground) .. .. . £21 0s./£23 0s. d/d  
Manganese Ore Indian—  
Europe (46% 48%) basis 6/s. 6d. freight .. .. . 73d./75d. c.i.f. nom.  
Manganese Ore (43% 45%) .. .. . 69d./71d. c.i.f. nom.  
Manganese Ore (38% 40%) .. .. . nom.  
Molybdenite (85%) basis .. .. . 8s. 11d. per lb. (f.o.b.)  
Titanium Ore—  
Rutile 95/97% TiO<sub>2</sub> (prompt delivery) .. .. . £29 per ton c.i.f. Aust'n.  
Ilmenite 52/54% TiO<sub>2</sub> .. .. . £11 10s. per ton c.i.f. Malayan  
Wolfram and Scheelite (65%) .. .. . 122s. 0d./127s. 0d. per unit c.i.f.  
Vanadium—  
Fused oxide 95% V<sub>2</sub>O<sub>5</sub> .. .. . 8s./8s. 11d. per lb. V<sub>2</sub>O<sub>5</sub> c.i.f.  
Zircon Sand (Australian) 65-66% ZrO<sub>2</sub> .. .. . £16/£16 10s. ton c.i.f.

## Mining Finance

### West Wits and the V.C.R.

One of the features of the Kaffir market in recent months has been the resurgence of interest in the West Wits mines, and in the finance house most closely connected, West Witwatersrand Areas. The publication of West Wits' report for the year to June 30 last makes this a good time to look at these mines in some detail.

One of the most important factors in the return to popularity of the West Wits line has been the emergence of the Ventersdorp Contact reef as something more than a second string to the Main or Carbon Leader reefs. Within the past year, three of the five West Wits mines have found that the V.C.R. is in some way exceeding expectations. At Libanon, for example, it is beating the book in two ways—values and payability, particularly in the drive south of No. 2 shaft advancing towards the Harvie-Watt position, have proved extremely encouraging, while in the far south of the mine it looks as though a larger area is underlain by the reef than had been thought.

At West Drie, of course, the Carbon Leader is of such exceptional richness that quite extraordinary results would be

needed from the V.C.R. if it were to become of anything more than secondary significance, especially in view of the fact that boring has now shown there to be more payable Carbon Leader in the lease area than had been thought. Nevertheless, the results of the first exploration of the V.C.R. are highly satisfactory. So far, 990 feet have been sampled, with 56 per cent proving payable at an average value of 1,766 in./dwt.

At the other mine concerned with the V.C.R., Venterspost, the improvement has been less dramatic, but still important, notably in the area to the south of the No. 1 sub-vertical shaft. Here, both values and payability on the V.C.R. have exceeded expectations. This has been an important factor in the improvement in this mine's ore reserve position.

It will, of course, be some time before the benefits resulting from these enhanced V.C.R. prospects filter through to the West Wits Areas profit and loss account. Nevertheless, the past year has not been uneventful for this company either. The major happening has been acquisition of a new subsidiary, New Consolidated, Free State,

Areas. This is a small holding company, the main assets being investments in Harmony and Free State Saaiplaas. The object of the take-over was to extend West Wits' interests, and there can be no doubt but that the list of West Wits' shareholdings looks a great deal healthier now than it did a year ago, not merely because of the inclusion of Harmony and F. S. Saaiplaas, but also because Western Areas features in it for the first time, while the investment in Western Deeps has been substantially increased.

As far as the financial side of West Wits' affairs is concerned, the most notable feature of the past year has been the fact that in spite of the increased capital resulting from the New Consolidated, Free State takeover, West Wits has been able to increase its dividends for the year to 3s. 6d. against 3s. 3d., involving the distribution of over £1,500,000, almost 50 per cent more than in 1957-8. This has been made possible by an expansion of more than £200,000 in the dividend receipts from the West Wits mines, and there is no reason to believe other than that there are several years of dividend increases remaining for West Wits Areas before the rate becomes stabilised. At the current level of about 74s. 9d. to yield over 4½ per cent, the shares' prospects must place them among the best investments in the Kaffir market.

### MALAYAN AND S. MALAYAN EARNINGS SHARPLY LOWER

As was only to be expected, the earnings for the year to June 30 last of both Malayan Tin Dredging and Southern Malayan, show further reductions from the levels of the preceding year, even taking into account the fact that the 1957-8 accounts were distorted by substantial special credits resulting from the acquisition of O.T.C. status by the two companies. Eliminating these and certain other special credits and debits, Malayan's profit has fallen from £201,925 to £183,902 after tax of £122,960 (£165,862) while that of Southern Malayan is down from £388,898 to £171,584 after tax of £196,559 (£292,513).

In view of the magnitude of these reductions, shareholders can hardly feel disappointed with the dividends paid or proposed by the two companies for 1958-9. Indeed, Southern Malayan's distributions for the year were quite substantially under-earned, the total of 1s. 3d. (against 2s.) absorbing £218,052. Malayan's total of 1s. 6d. is covered by profits, but by a margin of about £12,000 only. (Last year's total from this company was 1s. 10d.)

In Malayan's case, the full distribution is particularly praiseworthy because a new dredge is at present under construction. Including this year's small appropriation, over £900,000 has so far been set aside for this project, and this sum, together with £23,000 odd of the share premium account is to be capitalised, subject to shareholders' consent. If this is forthcoming, and there is no reason why this should not be so, the company will make a one-for-one scrip issue. The E.G.M. to consider the proposals will be held on December 18, as will the annual meetings of both companies.

### HARMONY RESTORED

Two doubts which have overhung the prospects of Harmony have been resolved, partially at least, by the annual statement by the chairman (p. 490).

Some shareholders may well have been alarmed by the sharp rise in costs from an average of 57s. 6d. in the 1957 financial

## LONDON MARKET HIGHLIGHTS

Tin shares were again the brightest spot in Mining share markets during the week. The reasons for the demand were still the availability of relatively high yields, good earnings prospects in the near future and in many cases the important asset of sound cash backing. There was also the growing feeling that next month's meeting of the Tin Council will ease further export restrictions which still hold back the Malayan producers to 80 per cent of normal production. The feeling was backed by the rise to £800 a ton in the tin price for the first time since 1956.

With stock becoming increasingly scarce, tin share prices moved quickly ahead. The Southern Malayan and Malayan dividends were considered to be very satisfactory while the fall in profits for the year to June 30 told of difficulties now past. Hopes of a brighter future were heightened when a day later Malayan Tin announced a one-for-one scrip issue and the shares jumped a further 2s. 3d. to 35s. ex-dividend. Rising income prospects lifted Tanjong 6s. to 23s. 9d. in three days and other good gains were registered by Tronoh (25s. 9d.) and Ampat (12s. 9d.). Consolidated Tin Smelters were another feature with a rise of several shillings at 51s. 3d.

Other Base-metal sections provided few features. In Coppers, Messina advanced 6s. 3d. to 137s. 6d. in anticipation of Wednesday's final dividend. Hopes of a maiden payment from Mangula helped to keep these shares a lively market at around 12s. 4½d.

South African Gold shares were again overshadowed by the activity in other markets. Matters were not helped by occasional pieces of bearish news includ-

ing rioting at Paarl (Cape Province) which worried London far more than Johannesburg.

A feature was the start of dealings in Union Corporation's latest gold projects in the Kinross area. The newcomers, Bracken Mines and Leslie Gold Mines, opened at 16s. 3d. and 10s. 3d. premium respectively over their 10s. par values. Interest soon waned, however, and the premiums fell to 14s. 6d. and 8s. 6d. before later recovering to 15s. 9d. and 9s. 3d.

Lorraine (36s. 6d.) became one of the few active stocks with sentiment being helped after an earlier setback by renewed Cape talk of high gold development values. On the other hand, Doornfontein eased to 32s. 6d. on the chairman's cautious remarks about future dividend policy—but the present rate seems safe enough and the shares yield as much as 9 per cent.

Similarly, Western Holdings' low value borehole which should have little significance for the mine as a whole depressed the shares by 4s. 4½d. to 161s. 3d. Fears of a possible cut in next month's dividend lowered Hartebeest to 30s. 9d. and Winkelhaak (25s. 3d.) were not helped by news of the one-day strike of rock-breakers at the mine.

Elsewhere, De Beers (which had previously fallen back to 193s. 9d. on profit-taking suggested by the view that scrip issue hopes had raised the price too high), later recovered to 199s. 4½d. following Cape and London investment demand. Rio Tinto (47s. 6d.), however, made little recovery from the setback which followed the U.S. decision not to take up its options on Canadian uranium produced after 1962.



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year to a peak of 69s. 9d. nine months ago. Since then, costs have declined, but until the quarter just past the fall had been by no means as fast as the rise.

The reason, it now appears, is that an unusually heavy development programme has been carried out, and, indeed, is still continuing. This sudden increase in tempo was partly the result of a backlog formed when the mine's hoisting capacity was too small, but probably more important was the co-incidence of an enhanced native labour supply with a need to step up off-reef development against future increases in production. The significance of this is that though costs have come down quite satisfactorily in the past two quarters, this has been purely a function of higher throughput, so that when eventually the development programme has, as it were, caught up with the mill, there should be a further decline, perhaps of the order of 10s. per ton.

The other doubt now cleared up, though not so satisfactorily, is of more recent origin, and stems from the apparent falling off of values and payability in the No. 2 shaft area, whence in course of time 60 per cent of mill tonnage will be drawn, compared with about 33 per cent at the moment. The problem, it now appears, is not so much the quality of the ore itself (although this has certainly deteriorated slightly) as the presence of that well-known spoiler, Khaki Shale in the hangingwall. Many investors recall that the occurrence of this soft and friable stratum in the hangingwall at the Freddie's mines was one of the causes of that company's difficulties. There, luckily, the resemblance ends. Whereas Freddie's also had to cope with copious faulting, not to mention an intolerable capital burden, the ground at Harmony seems otherwise well-behaved and the only difficulty is to solve the problem of hangingwall support. Until this can be done, the stopping width in this area will remain higher than in other parts, and the mill yield of the ore will be that much lower.

Nevertheless, at least investors now know the problems, and, indeed it appears that Harmony's future prospects are not as clouded as might have appeared from a study of recent quarterly reports alone. Is it too much to hope that future quarterly reports will carry more of this kind of information, instead of giving bare statistics, which can so often lead to an uninformed, and therefore, unsound, market?

#### STILL TWO-THREE YEARS' LIFE FOR RAND LEASES

At the end of the 1957-8 financial year, Rand Leases, Anglo-Transvaal's old producer in the West of the Rand goldfield, had barely one year's supply of ore in reserve, the decline during the preceding twelve months having exceeded 750,000 tons. Even taking into account the possibility of stepping up the proportion of mill-feed derived from sources outside the reserves, the chairman was unable to give the mine a life expectation of more than two or three years.

Since that time, those interested in this mine have seen the milling rate expand quite substantially, and it might have been thought that the eventual closure of the mine had been thereby brought even closer. When the ore reserve figures were recalculated at the end of June, it therefore came as a pleasant surprise to find that these had only declined by some 270,000 tons, in spite of the fact that the tonnage milled during the year had been the second highest total since 1952. It must be no less pleasing for the chairman now to be able to state that

Rand Leases still has two or three years' life left before the final irrevocable decline (statement p. 488.)

The saving factor for Rand Leases, as for so many old mines, has been the excellent native labour situation which has persisted for over a year. In many cases the improvement in production made possible at the old mines has been little short of dramatic, because the highly developed state of the mines enabled the additional workers to be employed in the mill or on other immediately productive tasks. This is in contrast to the position at the young mines, where each extra ton put through the mill requires its full quota of development.

#### TINTO BID FOR CAM AND MOTOR

An offer of 11s. a 2s. 6d. share for the issued capital of Cam and Motor Gold Mining (1919) has been made by the Standard Bank of South Africa acting on behalf of Rio Tinto (Southern Rhodesia). Cam and Motor directors recommend acceptance of the offer and full details of the bid will be sent out as soon as possible.

Costing approximately £2,500,000, the Rio Tinto group's latest bid follows recent acquisitions in the Southern Rhodesian gold industry and of an emerald property at Belingwe.

#### INCO EARNINGS IMPROVE

The net earnings of the International Nickel Company of Canada for the first nine months of 1959 improved to \$58,222,000, compared with \$30,321,000 in the corresponding period of 1958, and \$66,017,000 for the period to September 1957. The 1959 figure is equivalent to \$3.99, compared with \$2.07 and \$4.52 for 1958 and 1957 respectively.

Several factors have been at work in this improvement. Nickel itself has been in better demand, the effects of the U.S. steel strike being partly offset by increased calls from Europe. In addition, the improved prices recorded for copper have been important, while the demand picture for Inco's other major product, the platinum group metals, has been much more satisfactory this year than last.

Capital spending by Inco so far this year has totalled \$47,748,000. The estimated total for the year is \$65,000,000.

**New Corner House.**—Arrangements have been made for the sale of the Corner House, Johannesburg, by General Estates, a subsidiary of Rand Mines. Negotiations have been concluded for the purchase of eight stands in Marshall Township. These stands are bordered by Commissioner, Sauer and Fox Streets and it is intended to erect as soon as possible a new building on this site, which will be the headquarters of Rand Mines, and the South African companies of the group, including Pretoria Portland Cement Co. and Northern Lime Co. The new building will be known as the Corner House.

**National Mining Results.**—In the year ended March 31, 1959, the National Mining Corporation earned a net taxed profit of £31,732. This compares with £29,071 in the preceding financial year. No dividend is to be paid in respect of this period, but in view of an improvement in revenue since the end of the year, an interim payment of 5 per cent has been declared on account of 1959-60.

**Offer for Pusing Rubber.**—Pusing Rubber and Tin has provisionally accepted an offer of \$M.2,000,000 for the entire properties of the company made by solicitors on behalf of unnamed clients. The sale is subject to approval by shareholders, and Treasury consent is also needed.

**Harmony Lands and Minerals.**—Net profit for the year to June 30 last for Harmony Lands and Minerals, whose main assets are blocks of Anglo-Transvaal preference and Hartebeestfontein ordinary shares, totalled £4,598, compared with £4,385 in the preceding year. A dividend of 12½ per cent is proposed, costing £4,578. No distribution was made last year. Meeting, Johannesburg, Nov. 26.

**North Kalgurli's Better Profits.**—After all charges including taxation, North Kalgurli (1912) earned a net profit of £161,719 in the 52-week period ended March 31, 1959. From this, £1,445 is to be transferred to general reserve and a further £2,360 to reserve account (non-mining income). The recommended final dividend of 6d. makes an unchanged total for the year of 10½d. absorbing £144,375. The comparable profit for the preceding accounting period — 52 weeks to March 18, 1958 — was £141,275. The full accounts will be published towards the end of this month, and the meeting will be held on December 16.

#### BOARD CHANGES

Sir Ewen M. F. Fergusson and Mr. H. S. Orrock have been appointed to the board of Anglo-Burma Tin Company.

Mr. J. F. Chadwick has resigned from the board of Beralt Tin and Wolfram. (Mr. Chadwick's initials were wrongly stated to be J. T. last week.)

Mr. N. R. Crump, president of the Canadian Pacific Railway, has been elected a director of the International Nickel Company of Canada.

Mr. Basil S. Quirk has resigned from the board of Kalgoolie Electric Power and Lighting Co. Ltd., owing to the pressure of his other commitments.

Mr. T. A. Wellsted has been appointed a director of the Central Provinces Manganese Ore Company Ltd.

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## MOUNT ISA MINES

### MR. G. R. FISHER'S REVIEW

The twenty-seventh annual general meeting of Mount Isa Mines Limited was held on November 3 in Brisbane.

Mr. G. R. Fisher, Chairman of the Company, presided and in the course of his speech, said:

The Consolidated Net Income for the Company and its subsidiaries for the year ended June 30, 1959, was £4,030,722 after providing £1,247,775 for depreciation of buildings, plant and machinery, £173,039 for Mineral Royalties, £197,005 for Income Tax, and £1,896,250 for Income Tax Equalization.

Your Directors have again decided to make an appropriation from profits for General Capital Expenditure and Mine Development, and £1,900,000 was appropriated for this purpose. The amount of £400,000 appropriated for General Capital Expenditure and Mine Development last year has been transferred to Earned Surplus.

An interim dividend of 6d. per stock unit was paid on June 29, 1959. Your Directors recommend a final cash dividend of 9d. per stock unit for the year ended June 30, 1959, to be paid on December 31, 1959.

### Production and Operations

It is pleasing to advise that this year's production of silver-lead-zinc and copper ores reached record figures. The total ore treated was 2,278,579 tons, comprising 922,416 tons of silver-lead-zinc ore and 1,356,163 tons of copper ore. Production was 37.7 per cent. higher than the previous year when a total of 1,655,070 tons of ore was treated. The improvement in production was attributable to the installation of new plant and machinery and equipment planned under the Company's present expansion programme.

Blister copper production at 41,945 tons exceeded last year's production by 10,780 tons and silver-lead bullion production at 57,035 tons exceeded last year's production by 6,075 tons.

At the end of the Financial Year 38,685 tons of copper concentrate with a copper content of 9,779 tons had been railed from Mount Isa to Townsville for realization overseas.

Silver in lead bullion at 5,023,218 ounces exceeded previous year's production by 766,956 ounces; zinc concentrate production of 27,280 tons was 8,848 tons less than the previous year; zinc in zinc concentrate at 14,423 tons was 4,561 tons less than that produced last year.

### Ore Reserves

The silver-lead-zinc ore reserves were increased by 1,000,000 tons above last year's reserve to a total of 25,200,000 tons containing 5.6 ozs. silver, 7.8 per cent. lead and 5.8 per cent. zinc. Copper ore reserves at June 30, 1959, were 20,100,000 tons, an increase of 3,450,000 above the previous year.

The estimated grade of the copper ore reserves at June 30, 1959, was 3.7 per cent. copper compared with 3.75 per cent. copper reported in the previous year. Steady increases in ore reserves should be achieved as further development work proceeds.

Expenditure on expansion has been very substantial, as the following figures

will illustrate. The gross capital expenditure incurred by Mount Isa Mines Limited and its subsidiary companies from its own resources has been as follows:

Year to June 30, 1956 ...	£2,264,820
Year to June 30, 1957 ...	6,268,244
Year to June 30, 1958 ...	5,970,782
Year to June 30, 1959 ...	7,571,960
Total:	£22,075,806

The capital expenditure for the year ending June 30, 1960, is expected to be of the order of £8,000,000.

The Electrolytic Copper Refinery at Townsville was placed in production late in June 1959 by Copper Refineries Pty. Ltd. This plant was completed on schedule and should result in Mount Isa's refined copper being available for marketing sooner than it is under the present arrangement whereby blister copper is forwarded to other refineries.

### Mount Isa-Townsville Railway

Stockholders have been informed of the necessity for the rehabilitation of the Mount Isa-Townsville railway.

The Queensland Government recently decided to proceed with the rehabilitation of the Duchess-Richmond section which is the essential work to ensure reliable and adequate transport to meet the Company's transport requirements. A few days ago the Commonwealth Government agreed to assist the Queensland Government by making sufficient finance available to complete the major rehabilitation project.

The decision to proceed with this rail project is most gratifying.

The Report and Accounts were adopted.

## RAND LEASES

(Incorporated in the Union of South Africa)

### INCREASED TONNAGE MILLED

#### MR. S. G. MENELL'S REVIEW

The 27th annual general meeting of Rand Leases (Vogelstruisfontein) Gold Mining Company Limited will be held on December 3 in Johannesburg.

The following is an extract from the review by the chairman, Mr. S. G. Menell, which had been circulated with the report and accounts:—

The tonnage milled during the year under review was 2,206,000 tons (1958—2,014,000 tons) and, with the exception of the year ended June 30, 1955, the highest milled since 1952. The increase in milled tonnage is attributable to the larger native labour force which was available to your mine. Indications are that the native labour force will remain at a high level during the present financial year.

The increased milling rate coupled with economies effected at the mine resulted in a lowering of the working costs to 35s. 4d. per ton milled (1958—37s. 8d. per ton). Although the recovery grade declined by 0.106 dwt. per ton, the lower working costs resulted in a working profit of 1s. 10d. per ton milled compared with 11d. per ton milled for the year ended June 30, 1958.

The total profit for the year, including

sundry non-mining revenue, was £238,453 (1958—£122,015). Appropriations for capital expenditure and taxation totalled £25,204.

### Repayment of Capital

A reduction of capital was confirmed by order of the Supreme Court and a repayment of 9d. per share was made on April 24, 1959, to members who were registered in the books of the company at the close of business on April 3, 1959. The extent to which further repayments of capital will be made will be determined by the surplus funds available from time to time. In order to obviate the expense of applying to Court for confirmation of a reduction of capital on each and every occasion when such funds are available, an extraordinary general meeting has been convened for the purpose of considering certain resolutions for an overall reduction of the capital from 9s. 3d. to 3d. per share in such instalments and at such times as your board may determine.

Negotiations on a tributary basis were concluded with the holders of the mineral rights, Durban Roodepoort Deep Limited, for the right to prospect and obtain mining rights over all reef horizons, except the Kimberley Reef, in a triangular area of ground, approximately 127 claims in extent, along the eastern portion of the southern boundary of your mine. A prospecting permit has been issued by the Mining Commissioner to your company and application has been made for an endorsement of this permit to allow the company to win and dispose of precious metals from both development and stoping operations. Prospecting operations in this area commenced during January, 1959, and up to June 30, 1959, 3,330 feet of development were accomplished of which 1,975 feet of development on Main Reef and Main Reef Leader had been sampled. Of this footage 885 feet equivalent to 44.8 per cent proved payable at an average value of 6.74 dwt. per ton over a channel width of 37.7 inches, equivalent to 254 inch-dwt.

### Promising Development Results

In my review last year I mentioned that a life of two to three years could at that time be expected from the deep level area provided that the values and payability disclosed by development were maintained. During the year under review development on the Main Reef Series below the 36th level, including the prospecting area, totalled 34,400 feet. Of 17,345 feet sampled, 9,315 feet, equivalent to 54.1 per cent, proved payable at an average value of 10.80 dwt. per ton over a channel width of 24.9 inches, equivalent to 269 inch-dwt. These results are considered sufficiently promising to enable the mine to continue operating on the present scale for at least two and possibly three years from the beginning of the current financial year.

The high milling rate which has obtained over the past 12 months has not resulted in any shortening of the expected life of the mine because of the additional tonnage which it has been possible to mine profitably as a result of reduced working costs per ton milled. The rate of depletion of the ore reserve has been reduced and the total ore reserve of 1,920,000 tons at June 30, 1959, represented a decrease of 273,000 tons during the year under review as compared with a decrease of 758,000 tons in the previous year.

## SOUTH AFRICAN TORBANITE MINING AND REFINING COMPANY LIMITED

(Incorporated in the Union of South Africa)

### PRODUCTION MAINTAINED AT SATISFACTORY LEVEL PROGRESS OF FUTURE DEVELOPMENT INVESTIGATION

#### MR. S. G. MENELL'S REVIEW

The 25th annual general meeting of the South African Torbanite Mining and Refining Company, Limited, will be held on November 27 in Johannesburg.

The following is from the circulated review of the financial year to June 30, 1959, of the chairman, **Mr. S. G. Menell**:

#### Operations

The trading profit, before charging amortization and depreciation of fixed assets, directors' emoluments and interest on debentures, at £214,266 was £5,863 less than in the previous year. As it is now evident that the production of torbanite crude oil from the Ermelo mine can continue, at the least, throughout the current financial year ending June, 1960, it has been possible to reduce the provision in the past year's accounts for amortization of the mine by £40,000, compared with the amount provided in the previous year.

For the same reason, the amortization allowance for tax purposes for this year has been reduced and it has therefore been necessary to set aside an amount of £54,000, which is a considerably larger provision than was required last year, for income tax.

The net income earned during the year therefore amounted to £93,738 of which £86,680 has been set aside for dividend and £7,058 retained in the business.

The volume of refined products sold during the year decreased by 6.3 per cent compared with the previous year. This decrease was due, principally, to the decline in demand for bitumen of the quality which we were previously able to produce. This decline was, however, partly offset by the commencement during the year of sales of higher quality bitumens, which we have been able to produce from imported crude oil, as a result of the improvements to the refining plant, to which I referred last year. The total net revenue (after deducting excise duties) at £1,794,000 was £85,000 lower than last year, but this reduction was counter-balanced by lower costs.

Production of torbanite crude oil at Ermelo was maintained at the level required to fit in with the overall refining programme. 6,426,837 gallons were produced from 150,871 tons of torbanite at a yield of 42.6 gallons per ton compared with 5,891,276 gallons from 162,944 tons at a yield of 36.2 gallons per ton in the previous year. The extraction of torbanite remnants from the higher grade areas, mined some years ago, was commenced during the year, which increased the average grade delivered to the retorts.

Early in the financial year, the customs duty on imported petrol and the excise duty on petrol manufactured from imported crude oil were both increased by 2½d. per gallon to 14½d. and 14d. respectively. At the same time, the excise duty on petrol manufactured from our torbanite crude oil (as a local material) was increased by only 2d. per gallon to 9d. This differential has, to a small extent,

increased the payability of the remaining torbanite resources. On the other hand, due to the more ready availability of competitive higher quality coal, the revenue from our coal sales (which is taken as a credit to the cost of torbanite oil production) has further declined. In spite of this and other adverse factors, the production cost of torbanite oil was still held at a level competitive with imported crude oil prices, which declined during the year.

The payability of our Mine is dependent on the prices we can obtain for the refined products manufactured from the torbanite crude oil (which are controlled by the prices of competitive products). This, you will appreciate, added to the uncertainties of mining operations, makes it an impossible task for me to predict the remaining life of our Mine with any certainty. It is estimated, however, that production of torbanite crude oil will terminate during the 1960/61 financial year.

#### Capital Investment

To enable an additional imported crude oil to be processed and to provide for the new product sales anticipated, it was necessary to install, at our Boksburg Refinery and Durban ocean installation, further tankage and other facilities, which have now been completed, at a cost of about £200,000. In order to accommodate these extensions and to provide for possible future requirements, an area of about 50 acres of ground, adjacent to the Refinery, has been purchased from the Boksburg Municipality.

Capital expenditure during the year amounted to £116,500, including £66,668 on the above project and approximately £16,000 expended on the design of new refining plant in connection with the future development investigation.

Stocks of crude oil and refined products have been built up to a level commensurate with the present scale of the Company's operations. Due mainly to the increased investment in stocks and fixed assets, and the redemption of debentures, the cash balance decreased during the year.

Funds have been accumulated consequent upon the policy of providing for amortization of the Company's Mine assets in addition to the normal depreciation of the refinery and marketing plant and equipment. These funds have been held against the possibility of exploiting further torbanite deposits and for the modernization of refinery and marketing assets. Though every reasonable prospect of proving payable torbanite resources elsewhere continues to be investigated, we have not been successful in discovering further deposits to continue oil production when the present Mine is exhausted. As shareholders have been informed previously, any scheme for the continued operation of the refinery is likely to require considerable additional capital investment.

#### Future Development

In the longer term, I regret that I am not yet in a position to inform you of definite plans for the future development of the Company. Negotiations have been proceeding with the major oil companies for some time, in this regard, with the Government's approval. Considerable progress has been made and I am hopeful that a satisfactory solution will soon be reached.

It is a pleasure to express on behalf of the Board, our appreciation of the continued enthusiasm and enterprise shown by the employees of the Company under the present difficult circumstances.

## BURMA MINES LIMITED

reports that the operations of  
**BURMA CORPORATION (1951)  
LIMITED**

for the year ended June 30, 1959, resulted in an estimated **Net Profit** of **K.27,07,900 (£203,092)** as against **K.14,56,585 (£109,244)** for the previous year.

Details of Revenue, Expenditure, Ore Extraction and Production may be obtained from Central Registration Limited, 9, Basinghall Street, London, E.C.2, upon application.

Senior and junior geologists required for field work in North Borneo by Prospecting Company. Tours of service 12 to 15 months. Salary according to qualifications and experience. Write giving full details, experience, etc., stating age and whether married or single, to Box 148, c/o Barker and Howard, Ltd., 79 Fenchurch Street, London, E.C.3.

**AN ASSISTANT MINING ENGINEER**, qualified, required for Lode Tin Mine in Malaya with at least three years underground experience. Salary according to experience. Furnished quarters, medical attention and passages are provided and there is a contributory pension scheme in operation. Applications with details of experience and copy references to Box No. 2994 c/o Charles Barker and Sons Ltd., Gateway House, London, E.C.4.

**DAVIES INVESTMENTS LTD.**, Bankers, still offer 7½ per cent on sums £20 to £500 (withdrawal on demand) with extra ½ per cent on each £500 unit. Details from Investment Dept. MN, Davies Investments Ltd., Danes Inn House, 265 Strand, London, W.C.2.



## BLYVOORUITZICHT GOLD MINING CO. LTD.

The Twenty-second Ordinary General Meeting of shareholders will be held in Johannesburg on November 17, 1959. The following is an extract from the circulated statement by the Chairman, Mr. T. Reekie, dated November 11, 1959.

### Working Results

With the improved supply of non-European labour, it was possible to expand operations generally and the results obtained constituted some new records for the Company. The tonnages of ore mined and milled were the highest achieved since the commencement of milling operations in February, 1942 and the production of 877,250 ounces fine of gold exceeded the previous highest output in 1952 by 58,074 ounces. An improvement in yield per ton, following on a further reduction in the underground stoping width and an increase in waste sorting on the surface, contributed to this achievement. The working revenue during the year derived from gold at £10,994,105 was also a record. In line with the increased tempo of operations, however, the working expenditure increased sharply to £4,618,068. Nevertheless the working profit from gold was £6,376,037, an improvement of £1,164,422 on the profit for the previous year.

The increased amount of slime from current gold mining operations was all treated in the uranium plant, but, due to the limitations of the Company's sales quota, the quantity of slime drawn from surface accumulations had to be reduced. A reduction in the unit cost of production was achieved as a result of further improvements in operational techniques in the plant, and the working profit from uranium at £1,704,211 exceeded that of the previous year by £123,863.

The total working profit from gold, uranium and acid amounted to £8,241,521, which was an increase of £1,290,596 on the corresponding figure for the previous twelve months, and is the highest annual working profit recorded by the Company.

Net expenditure of a capital nature on mining operations amounted to £246,264. It is estimated that approximately £850,000 will be spent during the current financial year on the sinking and equipping of the new No. 4 Vertical Shaft and its ancillary services, and approximately a further £450,000 on the remainder of the mine and the reduction works.

Two dividends, of 1s. and 1s. 1d. per share respectively, were declared during the year.

### Development

The Directors' Report for the year ended June 30, 1959, deals fully with the changed pattern of development work during the year and with the consequential change in the development results obtained. It will, no doubt, be realized that the increase in the footage of exploratory reef development in the lower grade western portion of the mine and the decrease in the amount of reef development in the higher grade central and eastern areas have adversely affected the combined percentage payability and average grade of reef exposed. This change in the pattern underlying recent

results is likely to continue as long as the different methods of development referred to above are in operation and, in the circumstances, it will be appreciated that current development results should not be regarded as being of great significance in assessing the position and prospects of the mine.

### Ore Reserve

The payable ore developed increased by approximately 14½ per cent., the values for both gold and uranium being slightly lower mainly due to the inclusion of certain payable, although lower than average grade, blocks in the western portion of the mine.

Compared with the ore reserve estimate made a year previously, the available tonnage at June 30, 1959, increased by 5,000 tons to 4,665,000 tons, the stope width was reduced still further from 43.5 to 42.5 inches, and the gold and uranium values were higher by 0.4 dwt. per ton and 0.013 lb. per ton at 14.7 dwt. and 0.529 lb. respectively.

### Shaft Sinking

Sinking of the four sub-incline shafts of the "A" series continued satisfactorily during the year and the total footage sunk was substantially higher than in the previous year. Nos. A1, A2 and A3 Sub-incline Shafts have now reached their final depths. At September 30, 1959, A4 Sub-incline had 745 feet to go to its final planned depth.

Planning in connection with a "B" series of sub-incline shafts, which will reach the southern boundary of the mine, is at present under way. Following the Company's normal practice the cost of sinking these shafts will be included in working costs and, under present conditions, annual expenditure is likely to be approximately the same as that incurred in connection with sinking the "A" series of sub-inclines.

Precementation of the area surrounding the shaft site has proceeded satisfactorily. The two crosscuts from the 6th level haulage and the one crosscut on the 8th level, A2 Incline, directed to the site of the new shaft, have been started.

## HARMONY GOLD MINING CO. LTD.

The Ninth Ordinary General Meeting of shareholders will be held in Johannesburg on November 16, 1959. The following is an extract from the circulated statement by the Chairman, Mr. P. H. Anderson, dated November 9, 1959.

### Operations at the Mine

Operations during the year ended June 30, 1959, were again satisfactory and the tonnage milled was built up steadily from 85,000 tons per month at the beginning of the financial year to 141,000 tons in June, 1959. The average yield per ton milled for gold at 7.962 dwt. was lower by 0.061 dwt. than the figure for the previous year, while the yield per ton treated for uranium was very slightly higher at 0.504 lb. Largely as a result of the expansion in the scale of operations the working profit from gold increased to £2,120,974, while that from uranium and pyrites increased to £1,891,712, making a total working profit of £4,012,686. This working profit was

adversely affected by the necessarily heavy development programme which was planned not only to decrease the back-log from the period when development was restricted by lack of hoisting capacity but also to cater for the further expansion of production. Excluding shaft sinking, there was in fact an increase of 92.5 per cent in off-reef development during the year under review compared with the figure of the previous year. This placed an additional burden on working costs and, in spite of the increased tonnage milled, unit costs increased by 4s. 10d. to 67s. 5d. per ton milled. The usual full analysis of working expenditure is given in the Annual Report for the year under review.

A substantial footage in haulages, ore-passes and airways remains to be done, but steady progress has been made since the close of the financial year; 5,265 feet and 5,450 feet of off-reef development have been accomplished on 21 and 25 levels, respectively, and the 25 level twin-haulages had been advanced to a position 3,700 feet west of No. 2 Shaft by September 30, 1959. Nevertheless during the three months ended September 30, 1959, unit working costs decreased to 62s. 10d. per ton milled largely as a result of the higher tonnages now being sent to the mill. Additional long-wall faces are being established in preparation for further expansion and, as Shareholders are aware, this method of stoping has many advantages, not the least of which is improved ventilation on the working face—an important factor in the Orange Free State mines where the geothermic gradient is steeper than on the Rand. The presence of the "Khaki Shale" not far above the reef in the No. 2 Shaft Area has given rise to difficulties in controlling the hanging wall and the average stoping width is higher than it might otherwise have been. Every effort is being made to reduce this width.

### Expansion in the Scale of Operations

The fourth 50,000 ton per month unit of the gold reduction plant is on the point of completion. The sulphuric acid plant, with a rated capacity of 120 tons per day, was completed a few days ago and test-running has commenced. Based on the existing demand it is estimated that profits arising from the sale of acid will be of the order of £150,000 per annum. Foundations for the second rock hoist at No. 2 Shaft have been completed and it is anticipated that this unit will be commissioned during the first quarter of 1960. The normal hoisting capacity of the mine will then be in excess of 300,000 tons per month.

While the nominal capacity of the uranium plant is 120,000 tons per month it is in fact capable of handling tonnages in excess of this figure, and a monthly throughput of 144,000 tons has already been attained. The mine is well placed to produce uranium at competitive prices after the expiry of the present contracts.

### Finance

In my Statement to Shareholders last year, I mentioned that it was considered that capital expenditure during the year under review would approximate £3,000,000 and that a somewhat similar amount would be spent on capital account during the year ending June 30, 1960, in order to complete the expansion programme. In fact, £2,500,000 was spent during the last financial year and a re-assessment of the position indicates expenditures of £2,500,000 and £1,500,000



during the current and following financial years, respectively.

No Union of South Africa taxation or lease consideration is as yet payable by the Company. The assessed loss for tax purposes at June 30, 1959, was estimated at £10,285,000 which is some £1,400,000 less than the figure at the end of the previous year.

Since the close of the year Dividend No. 7 of 1s. 3d. per share was declared on September 14, 1959, payable to Shareholders registered in the books of the Company on September 30, 1959.

## CONSOLIDATED MAIN REEF MINES AND ESTATE, LTD.

The Sixty-first Ordinary General Meeting of shareholders will be held in Johannesburg on November 17, 1959. The following is an extract from the circulated statement by the Chairman, Mr. T. Reekie, dated November 12, 1959.

### Working Results

The gradual but progressive contraction in the scale of the Company's mining operations was continued during the year under review, and the tonnage milled at 1,492,000 tons was 248,000 tons less than in the previous year. Although the lower milling rate had the effect of increasing working costs per ton milled by 1s. 8d. to 38s. 3d., more selective mining, including an increased tonnage derived from the relatively higher grade Shaft pillars, resulted in a slight overall improvement in yield with a consequent increase of 2s. 4d. to 40s. 7d. in revenue per ton milled. The working profit of £174,802 for the year was therefore £30,474, equivalent to 8d. per ton milled, higher than the figure for the previous year.

### Accounts

The Company's net income for the year was £202,871. This amount, together with the unappropriated balance of £428,274 brought forward from 1958, gave a total of £631,145. Two dividends, each of 1s. 6d. per share, declared in December, 1958, and June, 1959, absorbed £187,140, leaving a balance of £444,005 in the Income and Expenditure Account at June 30, 1959.

### Development and Ore Reserve

At 25,241 feet there was a slight increase in the footage developed. This development, which was confined to certain selected internal areas of the mine, was mainly on reef. The footage sampled rose from 15,390 feet to 18,320 feet and although the inch-dwt. value on all five reefs improved, the percentage payability at 17.6 per cent was substantially lower than in the previous year. The bulk of the ore developed was stoped and milled during the year. The estimated total ore reserve at June 30, 1959, was 1,029,000 tons of a value of 5.5 dwt. over an average width of 43.5 inches.

### Position at the Mine

Despite the reduced milling rate it was not possible to replace the tonnage mined from reserves by development in the remaining areas of the mine and the total ore reserve declined by 507,000 tons to 1,029,000 tons at June 30, 1959.

Since the close of the financial year the remaining half of the stamp mill has been taken out of commission.

It is intended to continue the policy of gradually reducing the rate of milling during the current financial year and it is expected that all mining of the Kimberley and Bird Reefs will have ceased by June 30, 1960. It is anticipated that unit costs will rise still further during the current year and that there will be an increase in revenue per ton due to the more selective mining programme now in operation.

## WITWATERSRAND NIGEL

### MR. S. F. DENCH'S STATEMENT

The twenty-sixth ordinary general meeting of Witwatersrand Nigel, Ltd., will be held on December 10 in Johannesburg.

The following is the Statement of the Chairman, Mr. S. F. Dench, circulated with the Report and Accounts for the year ended June 30, 1959—

The tonnage milled during the year was 215,000, which was 4,600 tons more than that of the previous year. The grade of ore milled was 4.832 dwts. per ton as compared with 4.894 dwts. per ton for the previous year. Working costs were 9d. per ton higher at 54/8d. per ton milled. Certain wage increases granted to European employees amounted to approximately 9d. per ton, and rises in the price of stores and electric power accounted for a further 5½d. per ton. These increases have been to some extent relieved by very rigid economies.

### Development Results

The footage developed was further increased by 3,070 feet to 21,564 feet and the payability, which was 28.3 p.c., showed some improvement on the previous year, but the value of payable development was again somewhat lower at 272 inch-dwts. Although development in the Houtpoort Section continues to be disappointing, the ore reserve position in this section has been maintained mainly due to certain ore reserve blocks proving, on stoping, to be larger than was indicated by the original development, and to the inclusion of some new small

blocks of ore exposed by development. The position here has been further complicated by the occurrence of a major dyke on the southern extremity of the area of development. The extent of this dyke and its effect on the reef body is still being investigated. On 23 level where it has been crossed, it is 350 feet thick. Exploratory work continues in the No. 3 shaft area and the results obtained so far indicate that further work must be done before deciding on the best policy for the exploitation of this section. On the Poortje, No. 7 shaft section, development results continue to be satisfactory.

The estimated ore reserve at June 30, 1959, was 753,300 tons, averaging 4.8 dwts. per ton over a stoping width of 37 inches. This represents an increase of 14,300 tons and 0.1 dwt. per ton as compared with the previous year.

### Profit and Dividend

The net profit for the year amounted to £73,463 as compared with £87,441 for the previous year. This reduction was forecast by me in my review last year. It is expected that monthly profits for the current year will be between £5,000 and £6,000. Your Company still has no liability for Gold Mining Taxation.

Capital expenditure for the year under review amounted to £16,958, most of which represents the cost of the installation of an additional ball mill at No. 7 shaft reduction works. Against this expenditure an amount of £2,460 was recovered from the sale of certain shaft-sinking equipment no longer required. Capital expenditure during the current year is expected to be very low.

Dividend No. 5 of 5 p.c. was declared payable to shareholders registered at June 30, 1959.

There were no changes in the constitution of the Board of Directors during the year.

I have pleasure in expressing the Board's appreciation of the excellent services rendered during the past year by the Mine Managers, Mr. J. C. Ferguson and Mr. J. A. D. Wingfield, and I would also like to pay tribute to the efficient services rendered by the Technical and Administrative staffs at Head Office and the London Office, and the employees at the Mine.

## METALLURGICAL ASSISTANTS ROAN ANTELOPE COPPER MINES LIMITED NORTHERN RHODESIA

The above-mentioned company invites applications from metallurgists holding a degree or equivalent qualification and several years' experience in milling and flotation or allied operations. Duties will cover practical operating and supervision in all sections of the concentrator.

Starting salary range £1,092 to £1,320 per annum depending on experience. There is also a variable bonus, at present 36½ per cent on basic salary and a cost-of-living allowance, currently £65 per annum. Other benefits include contributory pension and life assurance scheme, hospital and medical services; share purchase and house purchase schemes.

Married accommodation at nominal rental immediately available.

Employee's outward passage to Rhodesia is paid by the company.

Applications giving particulars of age, qualifications and experience should be addressed to:—

Mine Employment Department,  
SELECTION TRUST LIMITED,  
Mason's Avenue, Coleman Street, London, E.C.2.

Please quote R.27 M.J.



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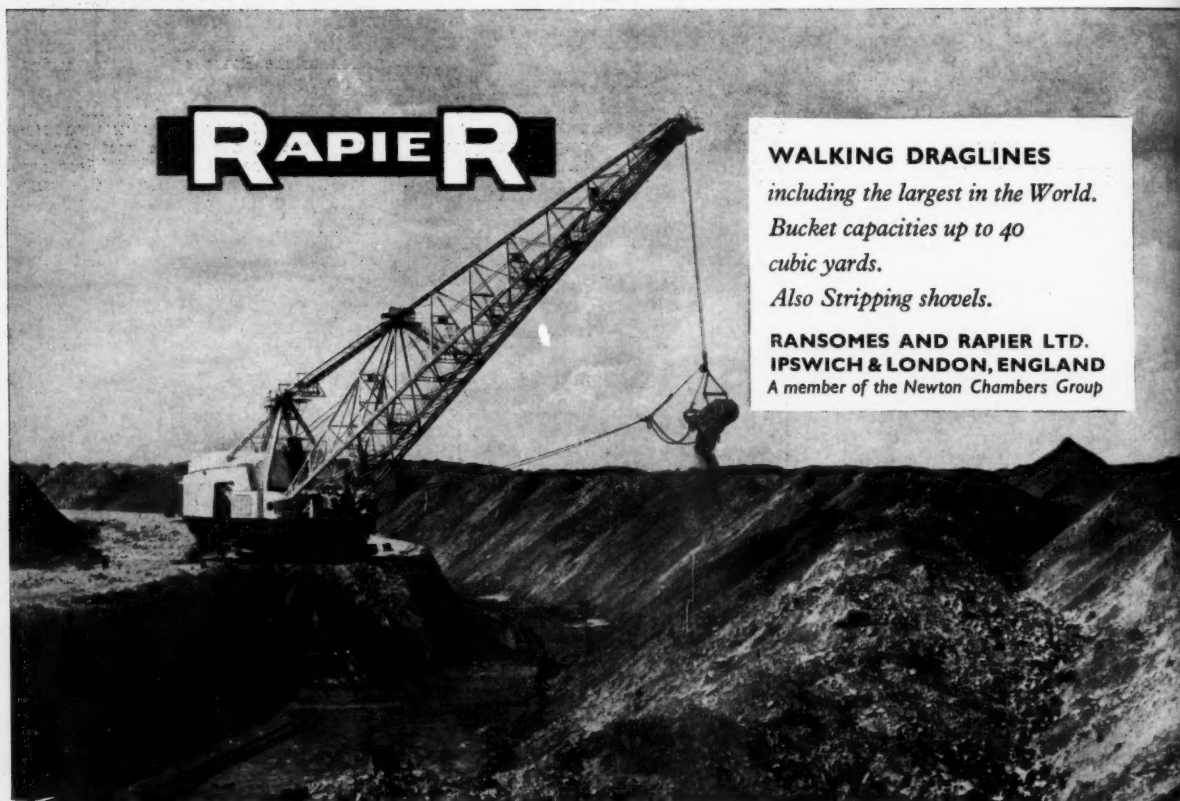
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